JANUARY 7, 1943

The IRON AGE

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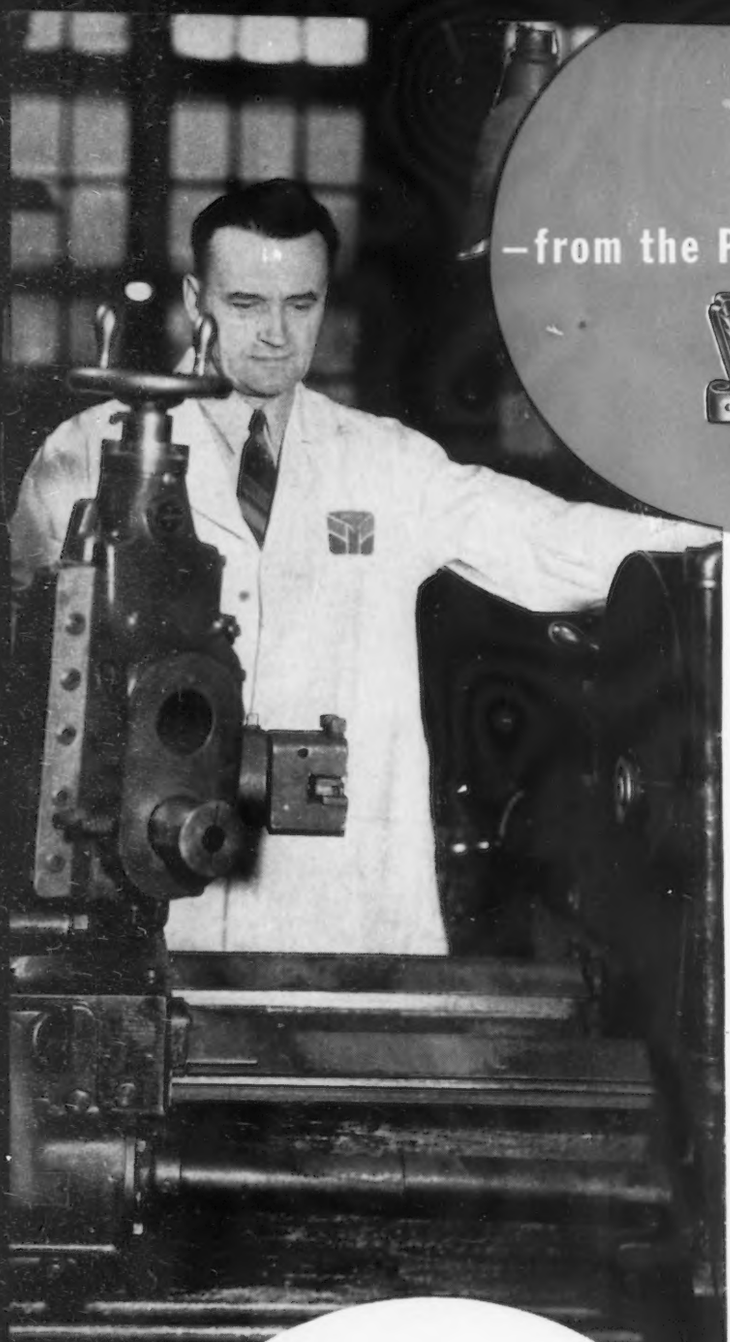
Pouring Electric Alloy Steel at Mesta

ARMY (E) NAVY

...Army-Navy "E" Flag, ...h two stars, flies ...r the Mesta plant.

MESTA MACHINE COMPANY · PITTSBURGH, PA.



Ideas for VICTORY

—from the Production Lines behind the Firing Lines

IDEAS FOR VICTORY — CHAS. F. MARSHALL — AWARDED BY WARNER & SWASEY

A Citation for Men in War Industry

HIS METHOD STEPPED UP PRODUCTION OF 20 MM. SHELLS

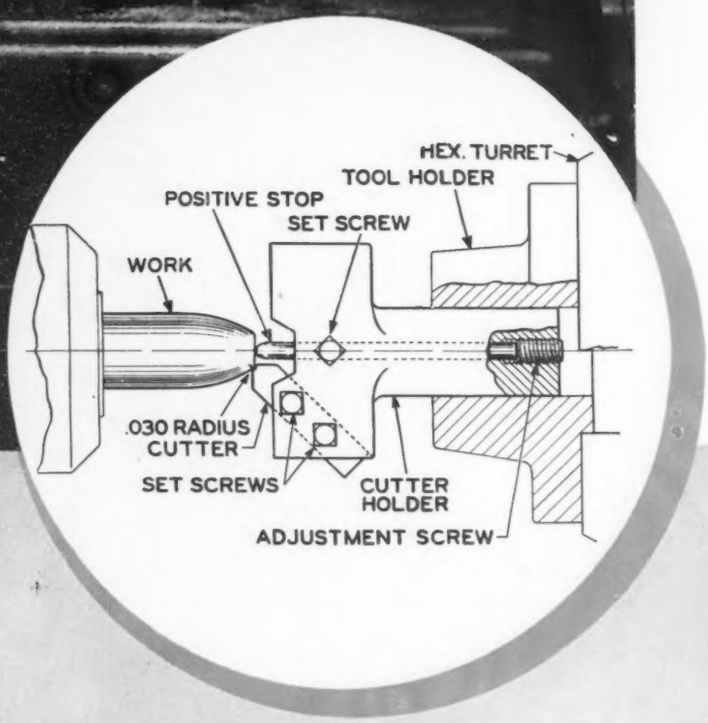
MANY machine tool operators deserve a lot of credit for applying individual ingenuity and resourcefulness to speed war production.

Such an operator is Chas. F. Marshall, setup man at the Oliver Farm Equipment Co., South Bend, Ind.

Operator Marshall developed a tool for machining a .030" radius on 20 mm. shells (see sketch). Because a stop is built right into the tool and locates from a finished face on the work piece, no particular care need be taken in loading work of slightly varying lengths into the spindle. Time was saved, accuracy improved, and production increased about 20%.

In addition to the Victory Pin, presented by Warner & Swasey, Mr. Marshall has been rewarded with a war bond by his company.

Many turret lathe operators have written us, telling how they have used the machines and tools at hand to best advantage. Many of these ideas are passed along in Blue Chips, a shop bulletin now being mailed free to the homes of over 38,000 turret lathe operators. Are your operators on this mailing list? Write Warner & Swasey, Cleveland, Ohio.



WARNER & SWASEY FOR VICTORY

YOU CAN TURN IT BETTER, FASTER, FOR LESS. WITH A WARNER & SWASEY

JANUARY 7, 1943
VOL. 151, NO. 1

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1 of 12 ANNEALING FURNACE Casings

delivered by Mahon in less than three month's time

Here is graphic evidence of the character of **WELDED STEEL PLATE WORK** that is daily produced by the Mahon organization.

This annealing furnace casing is one of twelve similar casings fabricated for the same concern in less than three month's time.

Manufacturers of equipment essential to war production are finding Mahon facilities of inestimable value where steel plate fabrication is required to complete their construction — and "delivery as promised" is vital.

Send us your blueprints for quotations. They will receive our immediate attention.

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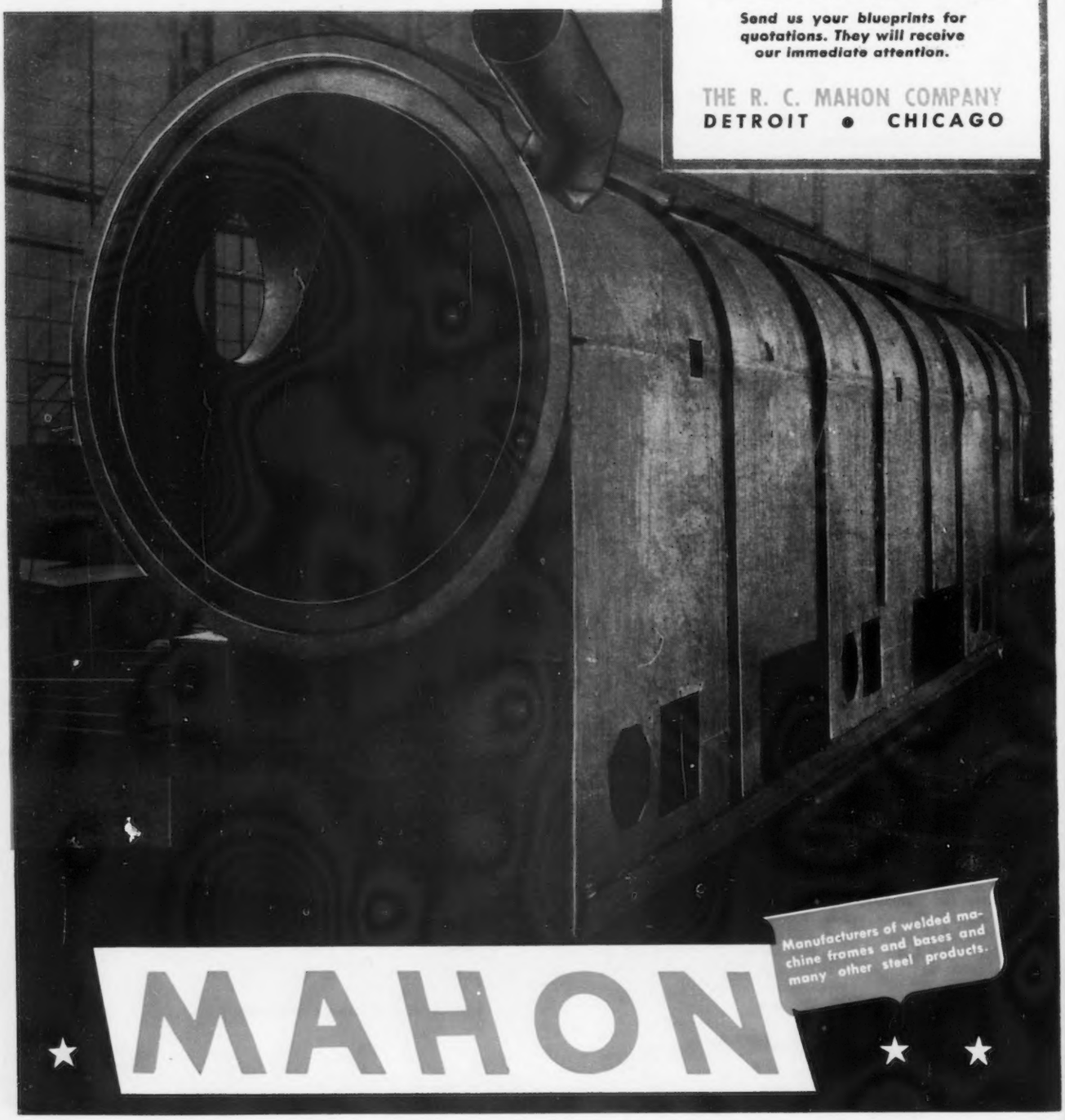


Manufacturers of welded machine frames and bases and many other steel products.

MAHON

THE IRON AGE

JANUARY 7, 1943

ESTABLISHED 1855

For a Successful New Year

FOR years extending back beyond the memories of most of our readers, THE IRON AGE, each year, has published two "special" issues. One of them, the Annual Review Number, has appeared the first week in each year. The other, published in the Fall, has marked the annual convention of the American Society for Metals and has been known as our "Metal Congress Number."

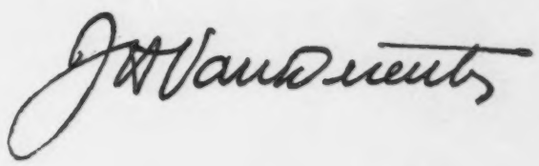
So many years have these two particularly notable issues appeared, and so appropriately have they fitted into the need and tempo of our industry that they have lost the connotation of "special issues" and have become recognized as institutions.

Not only have these issues received a cordial welcome from our readers but they have grown progressively in advertiser acceptance. And in the normal times of yesterday, being believers in the spirit of private enterprise and private profits, we as good publishers have endeavored to increase that acceptance. In respect to advertising, for example, we have heretofore and until now conducted special campaigns, by personal selling as well as by mail, in the legitimate and we believe laudable endeavor to fully capitalize these exceptional opportunities.

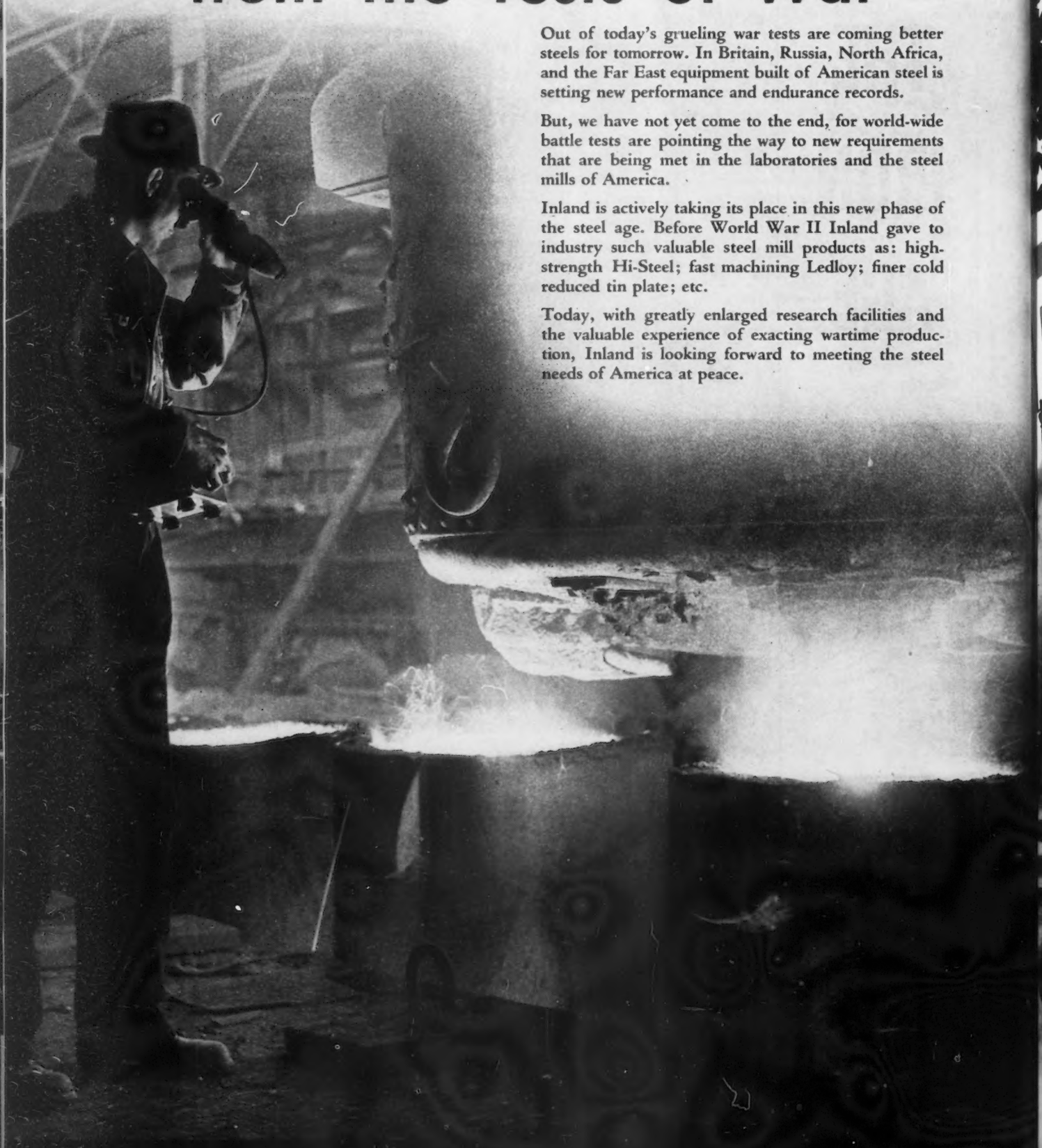
We have come to the conviction that from now until the end of our war emergency, these exceptionally large issues, which run to five or six hundred pages of text and advertising are not in order nor in public interest. It is true that in view of the small circulation of business and industrial publications as compared with the general magazines, and in view of the valuable specialized information furnished by them, one might find grounds for exception. One issue, for example, of *Life*, or *Fortune* or *Reader's Digest* would probably account for more paper than would 52 issues of THE IRON AGE.

However, that is not the point. The point is that to make 1943 a successful New Year, each and every one must do his or her part.

For the duration, therefore, there will be no more special solicitations for these two issues. Their editorial services will be continued as usual, but so far as advertising is concerned it will be "come what may."



Better Steels Are Coming— from the Tests of War



Out of today's grueling war tests are coming better steels for tomorrow. In Britain, Russia, North Africa, and the Far East equipment built of American steel is setting new performance and endurance records.

But, we have not yet come to the end, for world-wide battle tests are pointing the way to new requirements that are being met in the laboratories and the steel mills of America.

Inland is actively taking its place in this new phase of the steel age. Before World War II Inland gave to industry such valuable steel mill products as: high-strength Hi-Steel; fast machining Ledloy; finer cold reduced tin plate; etc.

Today, with greatly enlarged research facilities and the valuable experience of exacting wartime production, Inland is looking forward to meeting the steel needs of America at peace.

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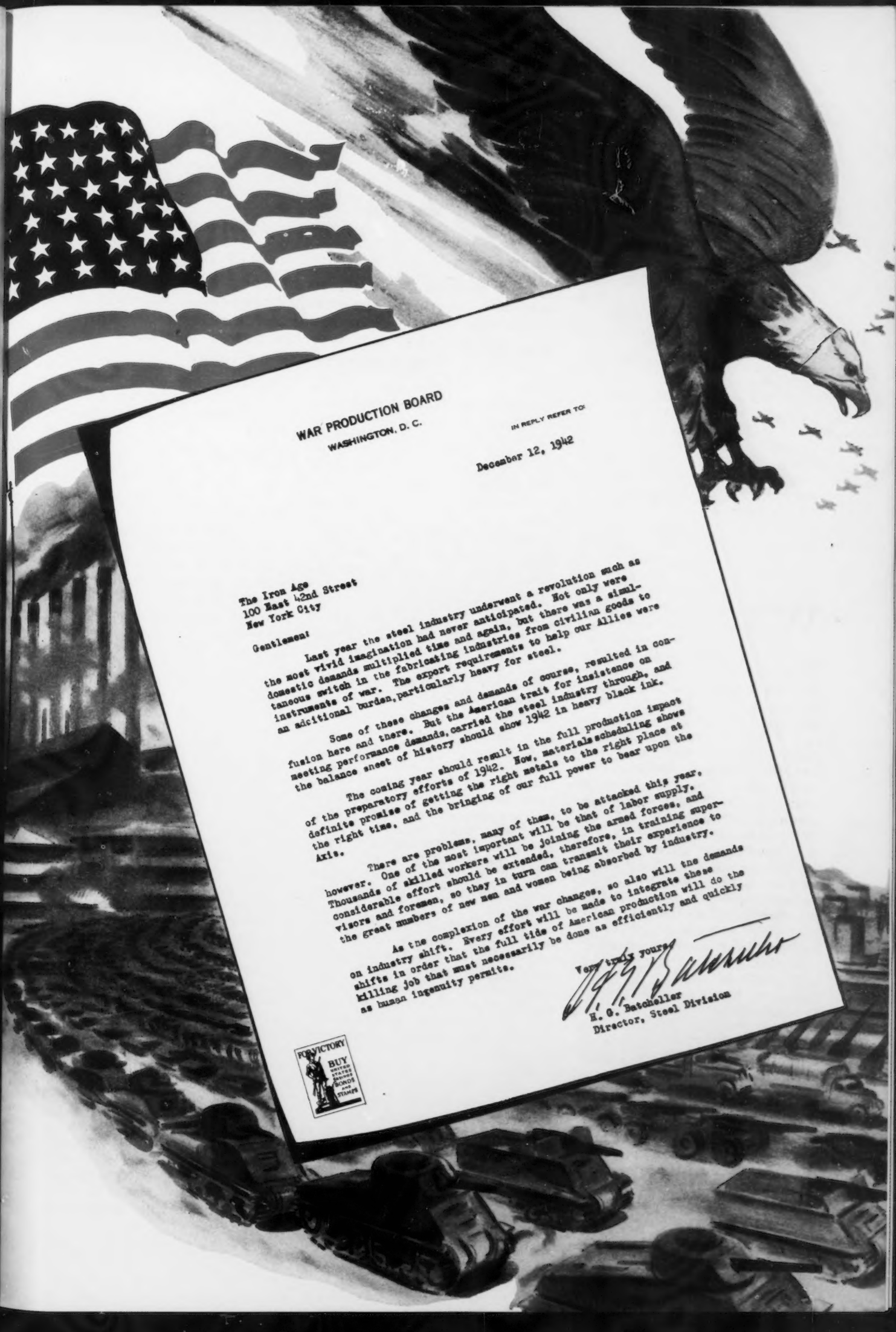


WAR PRODUCTION BOARD

WASHINGTON, D. C.

IN REPLY REFER TO:

December 12, 1942

The Iron Age
100 East 42nd Street
New York City

Gentlemen:

Last year the steel industry underwent a revolution such as the most vivid imagination had never anticipated. Not only were domestic demands multiplied time and again, but there was a simultaneous switch in the fabricating industries from civilian goods to instruments of war. The export requirements to help our Allies were an additional burden, particularly heavy for steel.

Some of these changes and demands of course, resulted in confusion here and there. But the American trait for insistence on meeting performance demands, carried the steel industry through, and the balance sheet of history should show 1942 in heavy black ink.

The coming year should result in the full prodmation impact of the preparatory efforts of 1942. Now, materials scheduling shows definite promise of getting the right metals to the right place at the right time, and the bringing of our full power to bear upon the Axis.

There are problems, many of them, to be attacked this year, however. One of the most important will be that of labor supply. Thousands of skilled workers will be joining the armed forces, and considerable effort should be extended, therefore, in training supervisors and foremen, so they in turn can transmit their experience to the great numbers of new men and women being absorbed by industry.

As the complexion of the war changes, so also will the demands on industry shift. Every effort will be made to integrate these shifts in order that the full tide of American production will do the killing job that must necessarily be done as efficiently and quickly as human ingenuity permits.

Very truly yours,

H. G. Batcheller
Director, Steel Division

FOR VICTORY BUY UNITED STATES DEFENSE BONDS AND STAMPS

1942 . . .

. . . A disconcerting string of complex confusions was somehow parlayed into a rather creditable industrial performance. But, 1943 brings a batch of new and untried emergencies that will test the native mettle of labor, management and politician.

By T. W. LIPPERT

Managing Editor, THE IRON AGE

WHEN viewed in broad panorama, the net results of the country's greatest industrial convulsion add up to a fairly neat achievement in 1942. All this despite the frightening imperfections in detail; a whole dark pile of political mockeries; early "boners" in ordnance and aircraft; persistent dilutions of the war effort with self-interest by certain industrialists and by some labor and farmer spokesmen; and newspapers with their anarchy of frothy buncombe and agony of artless floundering after technical will-o'-the-wisps. Somehow, someway, an inchoate ground swell of imperfect and undramatic individual effort complemented an industrial desire to hammer out a compact and solid piece of production —all this, partly as the result of and partly in spite of the congeries of bickering personalities and ineptitudes of OPM-WPB, in some unrecordable manner tallied up into an industrial performance considerably better than expectations.

Some $52,500,000,000 was poured into industry as it was converted, concentrated and stuffed into the pinching corset of all-out war production. Aircraft assembly of 49,000 planes (trainer percentage was fairly high) fell somewhat behind expectations, as did also tank and self-propelled artillery output of 32,000 units (light tanks predominating), while 17,000 anti-aircraft guns and 600 per cent increase in ammunition came closer to expectations, and the very capably planned merchant shipbuilding program jumped fivefold to 8,200,000 deadweight tons. Finished steel output lifted 1,500,000 tons over 1941 with alloy showing a 400 per cent gain; magnesium output doubled and redoubled many times, with the new Basic Magnesium plant alone rated at 3½ times total 1941 production; aluminum spurted almost 100 per cent above 1941; vast and ambitious production and technical schemes matured in copper, nickel, tin, molybdenum, vanadium, zinc, chromium, tungsten and such were the preliminary results that pressure on certain elements shifted from the hopeless to the uncritical categories.

For this year of 1943, the intensity of war production will be screwed up another 100 per cent, total expenditures to be in the neighborhood of $90,000,000,000, and only then will there be that desirable four-to-one smashing superiority over the Axis in the flow of materiel.

It has became rather fashionable of late to eye manpower as the critical factor involved in the inspiring production goals of 1943. This is rather significant in that materials, and at times the almost chaotic distribution of materials, in 1942 was the curse of every phase of war production. There is nothing to be gained in reviewing the depressing confusion and progressive deterioration of the priority system or its shotgun wedding with the Production Requirements Plan. Both of these are horizontal materials allocation schemes with compounding complexities, administered by a ballooning bureaucracy containing an excessively high percentage of inefficient and indifferent governmental employees, spilling through all the hallways of Washington, on which was superimposed an ever-shifting heterogeneous supervisory mixture of industrial riff-raff and highly capable individuals working under practically intolerable conditions, both mentally and physically. At the top, Mr. Nelson, albeit an excellent gentleman, was apparently inclined to talk overlong about being over the hump, to fill his string of 10 pipes each morning rather than unburden his terribly top-heavy organization of obvious non-producers and misfits, to continually back away from rather than embrace his opportunity to permit nibbling of his authority by the armed forces, and to suffer attacks on men from industry who had to be practically shanghaied to Washington.

The purge and rebirth of WPB, long anticipated and cynically awaited, is apparently about completed. Strong men have been brought into WPB—men, who like Jeffers actually fire incompetents; or Eberstadt, from the all-potent Army-Navy Munitions Board, to serve as liaison with the military

and administer materials with unemotional efficiency; Wilson, who organized aircraft production, and now controls all production; and a number of others down the line of tested ability and vision. And, while the base of the pyramid is still hundreds of useless workers that are a parody on talk of a labor shortage, WPB in general is outgrowing the acne and elbowing self-conceit of adolescence, and appears to be settling down to the pompous mediocrity of middle life. Apparently perfection is not desired as that great production engineer Henry Kaiser has not been placed at the elbow of Donald Nelson, as the Tolan house committee suggested.

Of course, even more promising than the improved personnel in the materials set-up is the new Controlled Materials Plan, or CMP, which is a vertical allotment system scheduled for full operation by July 1 for steel, copper and aluminum. Under it, prime contractors will submit a breakdown and time of delivery of materials requirements for approved end-products on which they are working. These Bills of Materials will pass through appropriate claimant agencies (Army, Navy, Aircraft, Lend-Lease, etc.) to the WPB Requirements Committee. When requirements are brought into balance, allotment numbers will be distributed to prime contractors, and from them to sub-contractors and suppliers. These allotment numbers will constitute a right to receive delivery.

CMP apparently was conceived and nurtured in the Army-Navy Munitions Board by Batcheller and Eberstadt, patterned basically on the English and German systems with a few embellishments and adaptations to the industrial mores of the U. S. First, it was visualized only for steel, and was unveiled as the premature and ill-fated so-called Reese Taylor plan. Only later, with Batcheller and Eberstadt in WPB, has Nelson backed this new scheme.

The great potential danger in CMP is that it has been expanded from steel alone to cover copper and aluminum also, and expectations are that even other materials will eventually be included. To accommodate each new material, certain modifications have to be made in the plan, and more serious is that over-all control shifts to a less efficient top supervisory group or agency. Possible inefficiency of inept over-all supervision may again bog down the underlying units, and in a short time the initial Division of Steel Industry Operators, for instance, may be weakened by such over-all authority, regardless of any personal promises of non-interference. This would seem to be rather unnecessary, as there is apparently no valid reason that prevents single-head integrated administration of these key industries whose maximum efficiency is essential to winning the war.

So much for the broad outline of production, past and present. Weaving throughout the fabric is a disturbing labor problem, both numerically and psychologically; a number of potent metallurgical and technological shifts, both practical and nebulous; rather futile arguments about quality of armament; much loose talk about the coming light metal-steel fight for supremacy; and the underlying uneasiness in all minds regarding post-war adjustments, the bulk of people quietly floundering between the extreme on one hand of reactionaries extolling the joys of Adam Smith unfettered, to an opposite extreme of the cold mathematical planning of the worshipers of econometrics who foresee the future in the terms of a world made perfect by technology and the applied social sciences.

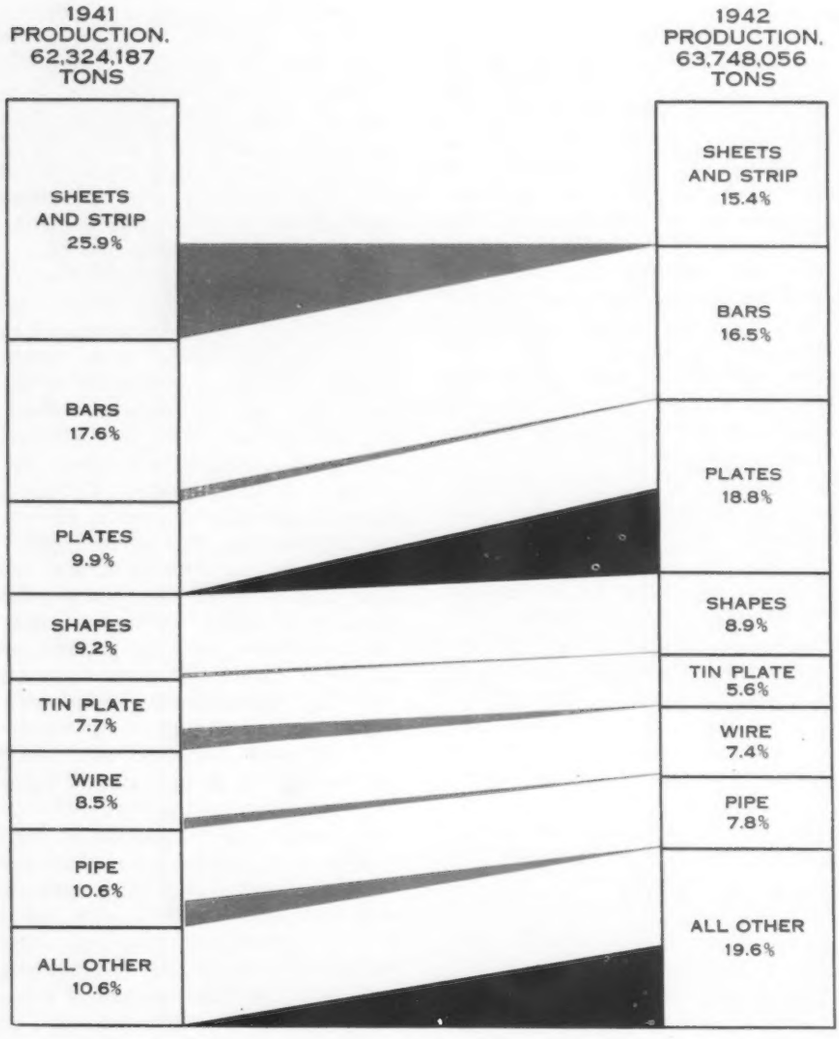
Steel, Friday's Child!

Some future actuary, morbidly humorous, may designate 1942 as the year of stomach ulcers with particularly high incidence in the steel industry. Articulated as it was with every phase of the rearmament effort, steel, in the past 12 months, was Friday's least favored child—a woeful football for every harpy-brained extremist to maul. Those frigidly tranquil individuals admitting of no problems dingdonged a counterpoint to the delirious refrain of others deploring a gaunt war industry famished for want of ferrous metals. Neither fierce extreme had basis in fact.

There was not enough steel in 1942. The shortage was, unfortunately, considerably emphasized by maldistribution via inept and progressive complexities of the priority system, spotty stock accumulations, drains of steel into non-essential uses, and certain unnecessary and over-accelerated construction projects. Even so, without those drains there still would not have been enough steel for all war demands. But, lest those "I-told-you-so" individuals should mock, it should be emphasized that without a 10,000,000-ton raw steel export load, the domestic steel and alloy position in 1942 would have been relatively of peanut proportions.

Actually, some 63,700,000 tons of hot rolled steel of all types (see Tables I and II) were produced in 1942, broken down from about 86,300,000 tons of ingots. With the most sanguine optimists last January predicting 83-84 million tons of ingots, 1942's performance represented a fair amount of relentless mill pressure and clever technical improvising, the seldom appreciated complications of which are described in detail on page 85. As regards metallics to support this record output, pig iron production of about 60,000,000 tons likewise exceeded expectations (details on page 93), and the startling return of 16,000,000 tons of purchased scrap to the mills (details on page 96) by dealers and brokers was an undramatic and unappreciated victory—a performance marred by 10 months of calm indifference and no little ignorance in WPB, shattered by a last-minute super-civilian scrap drive sponsored by newspapers, with professional scrap men being belatedly sucked into a maelstrom of price, segregation and delivery misunderstandings.

The details of the blotting up of a record 63,700,000 tons of steel in 1942 has been attended by considerable mystery and no little misinformed debate. However, the data in Tables I and II show relatively normal distribution patterns, both as regards products and consuming industries, with several dramatic



● Shift of product participation in total steel consumed during 1942, as compared with 1941. Note that the spectacular lift in plate output came by a sharp inroad into sheet-strip production, with all other products contributing to a lesser degree. See graph above and Table I below for details. Red indicates percentage decrease from 1941 to 1942, and black represents increase.

exceptions. The breakdown of production by product, Table I and Fig. 1, shows minor declines for most products, even for bars and pipe which support the shell and bomb programs, with a sharp and rather ominous constriction in tin plate deliveries. A terrific bite was taken out of sheet and strip production through killing off of automobile assembly. And, shipbuilding and construction were primarily responsible for lifting plate output to an unprecedented level. About the same story is told by Table II and Fig. 2 which trace steel into consuming outlets. Here, steel going into construction is just a little above 1941 consumption; agriculture, railroads, containers, machinery and oil and gas, all participated to a lesser degree, whereas the automobile industry accounted for less than 5 per cent of the total. The two multiplied drains on steel were shipbuilding and export, each accounting for over 16 per cent of the total steel.

Enlightening as last year's distributions are, however, more pertinent is the probable allocation of some 69,000,000 tons of rolled steel in this crucial year of 1943. Certainly, shipbuilding demands will lift 100 per cent or more, accounting for some 20,000,000 tons of steel; export will likely go some 1,000,000 tons higher to the neighborhood of 11,000,000 tons; the automotive-aircraft classification should rise and railroads will likely receive less steel. Containers should but probably won't lift if civilian and military feeding is to be maintained and if Lend-Lease and foreign rehabilitation are to go beyond the talking stage; agriculture will likely show little change; machinery will probably participate to a lesser extent, whereas pressing,

TABLE I

Production of Iron and Steel, by Product (1929, 1935-1942)

(In Net Tons and Per Cent of Total)

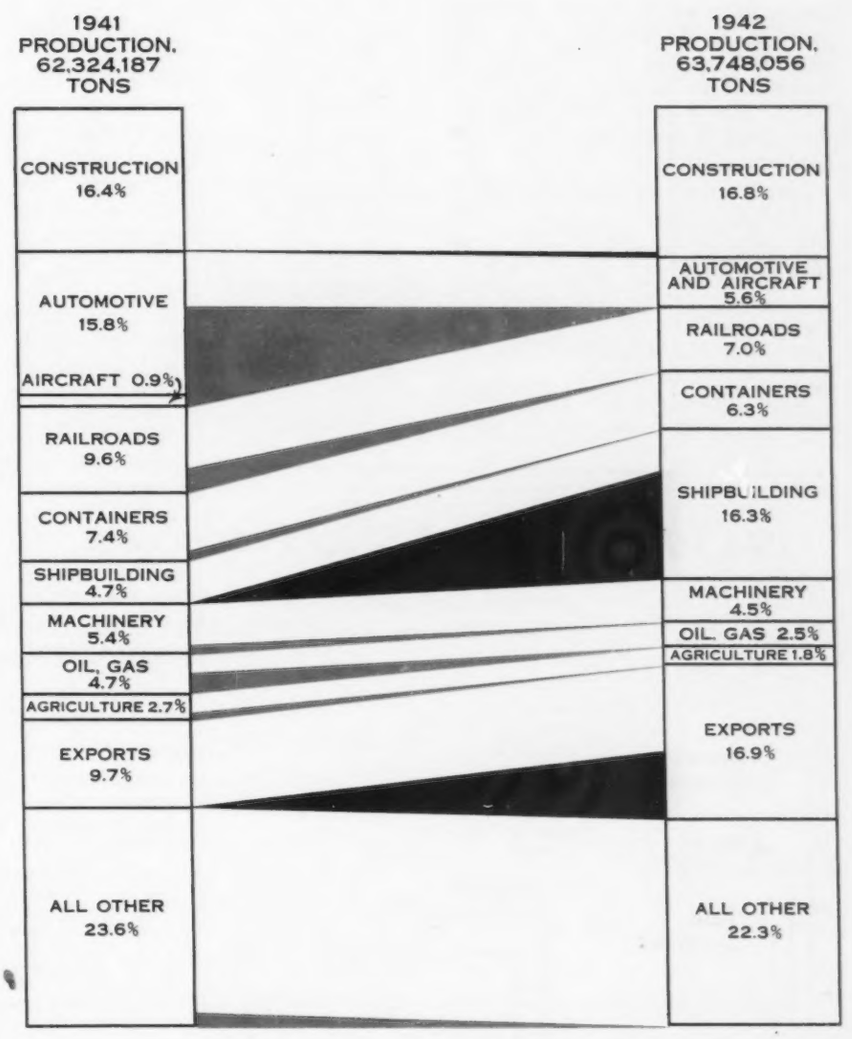
	Plates		Sheets and Strip		Shapes		Bars		Skelp and Seamless Tube Billets		Wire Rods		Black Plate for Tinning		Rails, Wheels, Ties Splice Plates		All Other	Total Production
Year	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	% of Total	Tons	Net Tons
1929...	5,624,798	12.2	8,688,726	18.8	5,351,382	11.6	8,314,316	18.1	5,487,339	11.9	3,510,538	7.6	2,418,274	5.2	4,389,938	9.5	2,212,435	45,997,748
1935...	1,629,987	6.1	8,761,924	32.6	1,959,709	7.3	4,767,187	17.8	2,582,104	9.6	2,733,689	10.2	2,307,462	8.6	1,193,199	4.4	905,037	26,840,298
1936...	2,829,950	7.5	11,447,319	30.2	3,245,346	8.6	6,822,492	18.0	4,225,272	11.2	3,357,626	8.9	2,945,232	7.8	2,053,851	5.4	930,456	37,857,544
1937...	3,632,438	8.8	12,023,275	29.2	3,670,068	8.9	6,755,012	16.4	4,705,954	11.4	3,370,405	8.2	3,308,576	8.0	2,320,896	5.6	1,391,732	41,178,356
1938...	1,919,835	8.1	6,948,749	29.5	2,082,685	8.8	3,484,923	14.8	2,882,471	12.2	2,361,630	10.0	2,191,905	9.3	993,684	4.2	703,069	23,568,891
1939...	3,101,981	7.9	11,858,772	30.4	3,358,985	8.6	6,138,350	15.7	4,348,630	11.1	3,680,297	9.4	3,468,358	8.9	1,994,796	5.1	1,117,384	39,067,553
1940...	4,323,408	8.9	13,783,700	28.4	4,232,346	8.7	7,885,261	16.4	5,029,966	10.5	4,351,848	9.1	3,625,551	7.5	2,399,494	5.0	3,028,795	48,660,369
1941...	6,199,575	9.9	16,142,759	25.9	5,724,836	9.2	10,978,698	17.6	6,583,495	10.6	5,268,423	8.5	4,818,922	7.7	2,961,999	4.8	3,846,080	62,324,187
1942...	11,974,023	18.8	9,828,111	15.4	5,686,255	8.9	10,474,736	16.5	4,950,405	7.8	4,550,397	7.4	3,585,152	5.6	3,561,937	5.6	9,137,040	63,748,056

NOTE: Data for 1929, 1935-1941 from American Iron and Steel Institute; 1942 figures are estimated by the author.

forming and stamping will perhaps lift sharply if the shift to steel shell cases approximates the fancy promises being made. Productwise, the sharp increase over 1942 will be in plates, with more moderate advances in sheet, strip and tin plate.

The 8,100,000 ton monthly rate of ingot production to be reached on the completion of the expansion program in 1943 will produce monthly approximately 5,780,000 tons of finished products. The distribution of these products and the raw materials required to make them are shown in the flow diagram on pages 52 and 53. Of particular significance is the large increase made in 1942 and to be completed in 1943 for alloy steel production which is so essential in the production of AP shot, armor plate and machine tools. The larger part of the alloy steel production is in the open hearth, but electric furnace capacity is being expanded so rapidly that by the middle of 1943 the capacity should total in the neighborhood of 6,153,000 tons annually. The total production of alloy steel in 1943 will probably range over 1,230,000 tons monthly.

Examining the probabilities of 1943 which involve sharp reductions in steel going into construction and machinery and widespread but temporary constriction in ordnance items such as shells, many an observer has become so enamored as to freely prophesy a comfortable steel surplus in 1943. What a titillant that is! But, in view of the greatly expanded demands of shipbuilding and export, with added load from the aircraft and expanded ordnance items such as



● Shipbuilding and exports expanded steadily in 1942, as compared with 1941 on a percentage of total tonnage basis, there being a complementary sweating down of automotive participation. Other consuming outlets were invaded to a minor degree, as detailed in the graph above and Table II below.

TABLE II

Steel Distribution by Consuming Industries (1929, 1937 to 1942)

(In Net Tons and Per Cent of Total)

	1929		1937		1938		1939		1940		1941		1942	
	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent	Tons	Per Cent
Agriculture	3,060,960	6.7	2,335,200	5.7	1,109,920	4.7	1,420,897	3.6	1,629,849	3.3	1,682,753	2.7	1,166,482	1.8
Aircraft	(a)		(a)		(a)		(a)		51,400	0.2	560,918	0.9	3,598,494	5.6
Automotive	7,352,800	16.0	7,814,240	18.9	4,053,280	17.2	5,906,358	15.1	7,964,923	16.4	9,847,222	15.8		
Construction	8,643,040	18.8	6,037,920	14.7	4,398,240	18.7	6,100,386	15.6	6,935,889	14.3	10,221,167	16.4	10,714,977	16.8
Containers	1,911,840	4.2	3,218,880	7.8	2,136,960	9.1	2,978,463	7.6	3,067,517	6.3	4,611,990	7.4	4,070,824	6.3
Furniture, furnishings	700,000	1.5	1,494,080	3.6	868,000	3.7	1,182,235	3.0	(b)		(b)		(b)	
Machinery, tools	2,028,320	4.4	1,804,320	4.4	831,040	3.5	1,460,000	3.7	2,330,365	4.8	3,385,506	5.4	2,852,077	4.5
Oil, gas, water, mining	4,117,120	8.9	3,034,080	7.4	1,820,000	7.7	1,841,599	4.7	1,900,286	3.9	2,929,237	4.7	1,585,969	2.5
Pressing, form., stamp.	(c)		(c)		(c)		659,864	1.7	2,296,355	4.7	3,677,127	5.9	2,782,752	4.4
Railroads	8,162,560	17.7	4,686,080	11.4	1,443,680	6.1	3,250,022	8.3	4,019,219	8.3	5,983,122	9.6	4,400,444	7.0
Shipbuilding	346,080	0.8	390,880	0.9	389,760	1.7	517,771	1.3	999,858	2.1	2,929,237	4.7	10,369,768	16.3
Exports	2,495,350	5.4	3,032,960	7.4	1,752,800	7.4	2,594,700	6.7	8,098,874	16.6	6,045,446	9.7	10,800,000	16.9
All other	7,179,666	15.6	7,329,716	17.8	4,765,271	20.2	11,155,458	28.7	9,365,834	19.1	10,470,462	16.8	11,406,271	17.9
TOTAL	45,997,746	100%	41,178,356	100%	23,568,951	100%	39,067,553	100%	48,660,369	100%	62,324,187	100%	63,748,056	100%

NOTE: Distribution 1929 to 1938 by M. W. Worthing, based on data from The Iron Age; 1939 to 1941 from The Iron Age, various Government reports, and AIS estimates, with jobber tonnage distributed and other alterations made by the author according to the technique devised by M. W. Worthing; 1942 data are estimates by the author.

(a) Negligible, or not available and included in All Other.
(b) Included in Pressing, Forming, Stamping.
(c) Included partly under Furniture and Furnishings and partly under All Other.

tanks, guns, shells, bombs, and steel shell cases, to proselytize a steel surplus is to the author a hunk of wishful thinking that could well be tucked into a cubby-hole alongside visions of a cowed Axis by year's end.

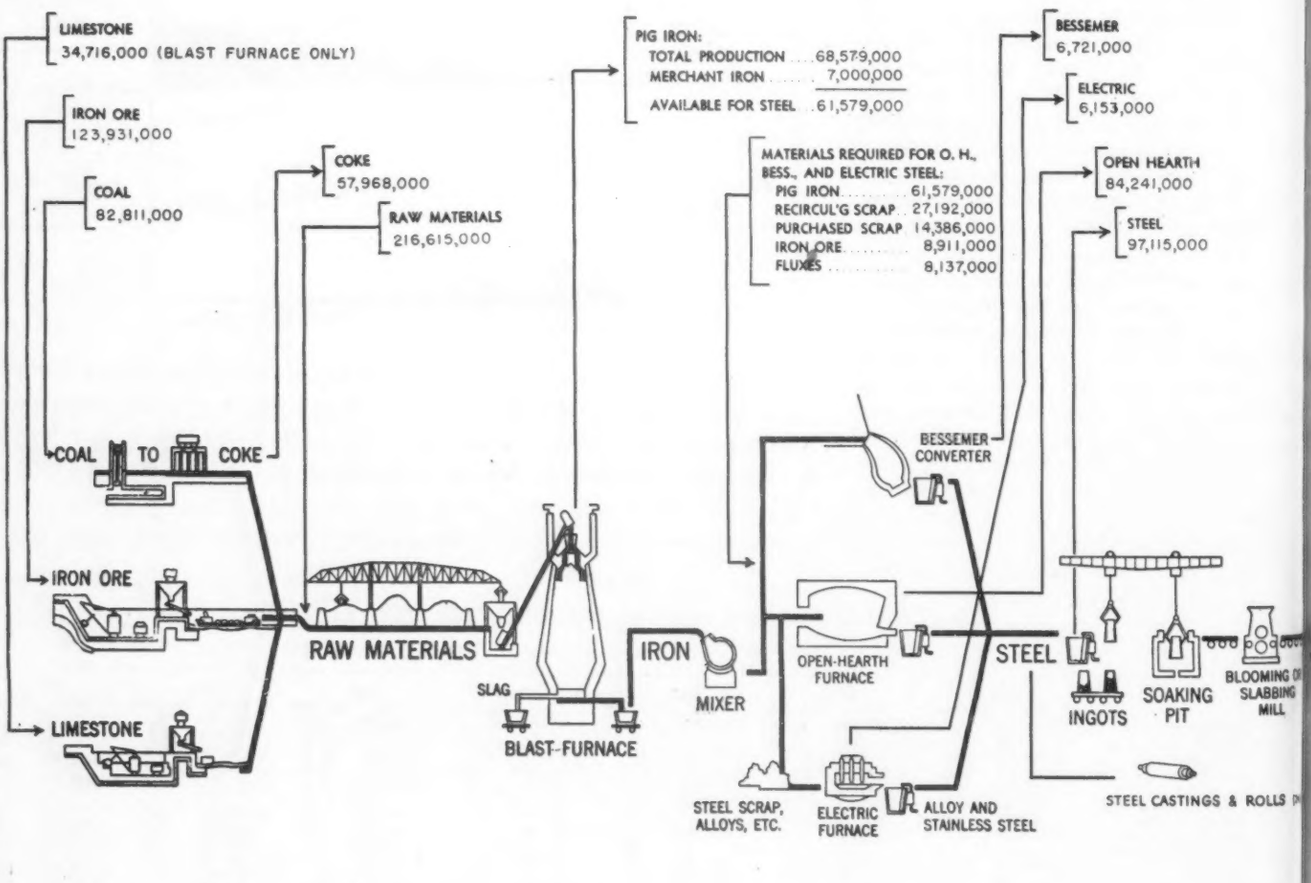
Any production of 97,000,000 or more tons of steel ingots in 1943 will involve unprecedented pressure on available metallics. Therefore, the problems involved in supplying adequate iron ore, pig iron, scrap and so-called sponge iron, are of first-rate importance.

As regards iron ore, over 2,000,000 tons more were brought down in 1942 than had been anticipated, and currently there is about 8,000,000 tons more on lower lake docks than at a similar period a year ago. And, as for the 100,000,000 tons scheduled to come down from Superior in the 1943 season, new boats seem to assure complete success without dependence on any unconventional practice as winter or rail movement (see page 91 for details). A factor tending to ease or to supplement the ore supply will be the installation of considerable sintering capacity during the year, perhaps even approaching an average 30 per cent of ore requirements, a ratio that only Republic currently has completed or underway. There are really enormous flue dust inventories scattered around various plants, in several instances on the order of many million of tons. Sintering equipment would tend to absorb these inventories into production.

Although ore receives the bulk of attention, it is relatively in third position among the factors influencing pig iron supply in 1943; coking coal will be the second most serious problem, not that underground reserves are not plentiful indeed, but the physical job of get-

1943 Flow Chart of Steel Production

. . . Productive Capacity With Raw Materials Required at Completion of Expansion Program During 1943. WPB's Distribution of Finished Steel for the Year Is Shown to the Right. (All Figures in Net Tons)



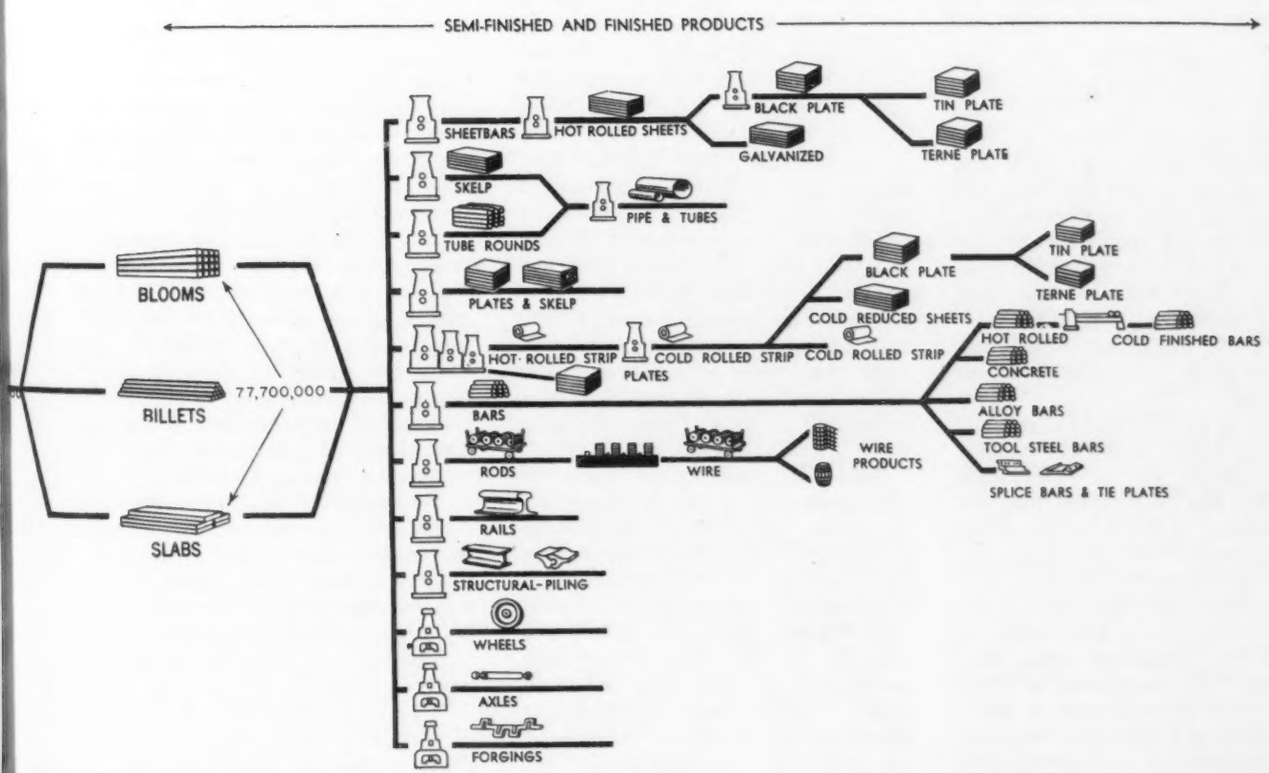
ting the greatly increased tonnages out demands that traffic in every little entry pile up to a thoroughfare density; and, the tightest squeeze in 1943 will likely be in coking facilities, both by-product and bee-hive.

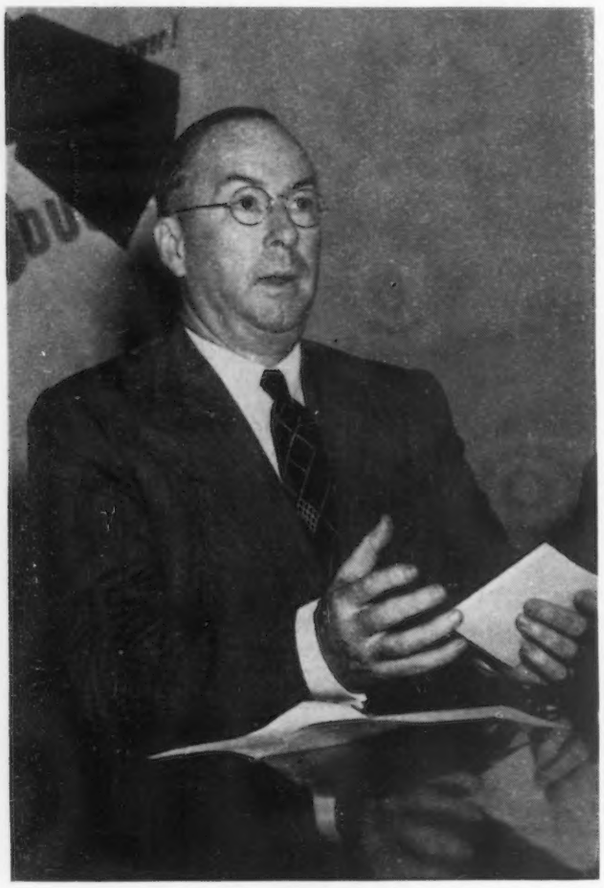
While the limited reserves of very high grade ore in the Superior region is one of the oldest and best documented facts in the steel industry, quite a bit of excitement developed late in 1942 regarding the inevitable liquidation of the reserves. Not having enough war worries already, many readers of various articles in *Saturday Evening Post, Time*, etc., came to the conclusion that the war effort would be jeopardized for lack of ore, and some papers freely prophesied the end of U. S. steel supremacy. To some the shock was somewhat akin to seeing Santa Claus in a zoot suit. However, all the worry seems to the author like borrowing trouble, as at worst there is 10 years' supply, and since most reserves are set up on an extremely conservative basis, there is every likelihood of a 20-year supply. Lower grade reserves are unlimited, and what with improvements in beneficiation inevitable in that period, the swing over to the poorer ores when the time comes will likely be gradual and cause hardly a ripple, either technically or cost-wise. Recently, also, Canada's Steep Rock ore body has again hit the limelight as the salvation of supposedly ore hungry U. S. mills. Julian Cross' Steep Rock property is a well known deposit which sucked in considerable money in the 20's. The geology and metallurgy of the lode was for the first time described in detail in THE IRON AGE (July 20, 1939). The ore is excellent metallurgically, but unfortunately lies at the bottom of a

POSSIBLE DISTRIBUTION OF APPROXIMATELY 8,100,000 INGOT TONS PER MONTH CAPACITY TO SEMI-FINISHED AND FINISHED STEEL PRODUCTS

Product	N. T. Per Month
Semi-Finished (for shipment)	700,000
Structural Shapes	375,000
Plates	1,300,000
Rails	185,000
Bars	1,000,000
Pipe and Tubes	430,000
Rod and Wire	370,000
Tin and Terne Plate	250,000
Sheet and Strip	900,000
Miscellaneous	270,000
Total	5,780,000

(69,000,000 Net Tons Annually)





• • • *Donald M. Nelson*

A storm gathered as he talked of "over the hump".

lake, the draining of which and opening of a pit would involve considerable money. It is said that the Canadian government is running power into Steep Rock and intends to put a rail line into and build port facilities at Port Arthur, while the United States will finance opening of the ore body. Right now, however, the whole proposition seems a little confused, and there is little expectation that Steep Rock will have much participation in the war effort.

Scrap, in 1943, will require most intelligent handling if it is to carry its full share of the steel load. While Mr. Batt has stated that the scrap section of WPB is one of the most efficient divisions, some observers of Rosenwald's conservation division find difficulty in detecting very much awareness to realities or inspiration from that direction. The headaches of 1943 are going to be migraine in character unless a little more realistic price schedule is established and successive civilian drives are more closely integrated with scrap professionals so that the junk can pass through processing and sorting yards in an orderly and constant stream.

Still a relatively untapped source of fairly good scrap is the many old slag dumps around the country. In 1942 about 300,000 tons of this material was salvaged, with Republic the biggest single participant. At least 1,000,000 and certainly 2,000,000 tons could be rather easily realized in 1943 if operators can in some way get releases on magnetic pulleys and handling equipment.

One discouraging permanent loss of excellent scrap and of even more strategic tin was involved in the wretched muddling of tin can salvage. In 1942 less than 5 per cent of the tin cans used went through the hands of detinners. Estimates are that during 1942 there was detinning surplus capacity available for processing "prepared" cans of nearing 500,000 tons per year. Shipments of "prepared" cans were probably never at the rate greater than 60,000 tons per year. Therefore, it is evident that very considerably over 1000 tons of recoverable steel scrap and 10 tons of tin were irrevocably and needlessly lost each day.

The fact that there were no nearby detinning plants in certain areas was far from an insuperable difficulty. Vulcan, for instance, was receiving at Neville Island, Pa., shipments of "prepared" cans from such distant points as Texas and Florida. In the New York area people still are not being asked to clean or flatten cans, the recovery therefore being only a fraction of the potential. In most other sections of the country, civilians were told not to save their cans, whereas many of these flattened or shredded cans could have been shipped to detinners who still had unused capacity. And while shredders and detinners are being built over the country, even a half-hearted publicity campaign could have urged civilians to save and accumulate their cans to create a backlog of material for the plants when they went into operation. None of this was done and a surprisingly small percentage of cans is being intercepted before it reaches the incinerator or dump, the consequence being the loss of a million or so tons of steel scrap and many thousands of tons of tin. As for the future, much of the heavily tinned cans will go to the military and will not be recoverable, and all the new detinning plants will be finished about in time to receive the increasing stream of lightly tinned or lacquered cans now going into civilian consumption.

A great deal is yet to be done in the proper segregation and handling of alloy scrap in the country's industrial plants, and in fact the entire alloy steel position is dependent on far more care and forcefulness in establishing this practice. With proper segregation the ferroalloy requirements for NE steels can be dropped to almost a negligible point. For munitions, probably less than 30 per cent of the steel gets to the battle fields, while the remainder is now flowing back in a flood of alloy borings and turnings which is becoming quite a serious problem. Unless greatly increased briquetting facilities are installed there will not be full utilization made of this valuable material.

Since the electric furnace is primarily a melter of selected scrap (being a relatively inefficient refiner for removing carbon, phosphorus and silicon), the necessary millions of tons of plate clippings and low phosphorus structural scrap just do not exist. Even now it is sometimes necessary to ship crop ends long distances from rolling mills serving open hearths to hungry electric steel plants. There will be completely inadequate supply of high-grade, low-phos scrap to support a greatly expanded electric furnace output in 1943 despite such expedients as the use of numerous open hearths to melt down unselected scrap to be poured into ingots and analyzed for use in

electric furnaces. For instance, the entire output of Mansfield Sheet & Tinplate Co., a company currently remelting scrap and pouring it into ingots, goes to Republic and Timken at a price with OPA permission, of $5 above the market. Over 6½ million tons of aircraft quality alloy steel ingots alone are expected in 1943, and several companies are taking unprecedented steps to ease their scrap problem. Copperweld Steel Co., for instance, is one of several companies setting up a triplexing scheme, whereby alley scrap may be melted in a cupola, then desulphurized in the ladle with caustic soda, blown in a bessemer to remove carbon and silicon, and subsequent chemical dephosphorization in a mixer, then charging hot (or cold) into electric furnaces. Republic, on the other hand, is banking on a direct reduction, or so-called sponge iron, unit at Warren, Ohio, to turn out a small volume of high grade melting stock, by hydrogen reduction of magnetite concentrates. Planned output is 100 tons a day, the plant cost to be about $450,000. If successful, the 100 tons would take care of about 1/30th of Republic's scrap requirements.

This Republic direct-reduction venture came as the climax to almost a year of political, technical and emotional wrangling about the practicability of widespread construction of sponge iron units throughout the country. The spokesman for sponge iron enthusiasts was Senator Joseph C. O'Mahoney of Wyoming, who was vocally suspicious of the technical vision of established steel makers and inclined to read fear of ruinous competition as the motive underlying opposition to a building program. Steel makers, on the other hand, were so very conscious of the miasma of technical and economic uncertainty ever blanketing all direct-reduction schemes, and were particularly fearful of sponge iron construction draining off equipment so badly needed to complete blast furnace installations already far behind schedule. The compromise of a $600,000 appropriation for Bureau of Mines experimentation with its own pet rotary kiln direct reduction scheme at Laramie, Wyo., and at Boulder City apparently satisfies Senator O'Mahoney and is a matter mostly of academic interest to the steel producers. It has been said that the Krupp-Renn process, originally designed within the autarchy movement under Hitler to exploit German siliceous low grade ores, is being used at the new Hermann Goering Works, and also by the Japanese. However, the most recent advices are that neither country is using a direct reduction process.

Of the innumerable schemes for direct reduction which have tortured the steel industry and like May flies have had only a brief afternoon of existence, the Brassert-Cape process to be employed by Republic is by far the most promising, and was scheduled for approval by Hauck of WPB long before the politicians started flailing the industry. Technically it is pretty sound, but even more important it is being designed by experienced and highly skilled engineers, and will be operated by a smart steel personnel.

• • • *Henry John Kaiser*
(Barnum + Bunyan)[5]

Herman A. Brassert is an engineer of considerable renown, and his company has designed numerous blast furnace units here and abroad. A. T. Cape has worked for both the U. S. Steel Corp. at Duquesne and for Republic, later forming the Coast Metals Co. to experiment with metallic sands on the Pacific Coast using the Herreshoff furnace. Apparently Mr. Cape will be associated with Brassert only on the Republic unit.

The process itself consists essentially of two steps: (1) Ore treatment and purification, (2) reduction and compacting of the reduced material at temperatures below the softening point. The iron ore is crushed until it is very fine (less than 60 mesh) and then it is subjected to the most suitable concentrating methods, such as gravity or flotation, magnetic or electrostatic separation, followed by gravity air tabling. The result is quite a pure mineral which may contain only a small percentage of gangue, which then may be fed to the reduction unit.

The reduction takes place underneath a Herreshoff furnace which serves to prepare the ore for the final reduction. The Herreshoff furnace is used in industry for a variety of purposes, as for instance for roasting copper and other nonferrous ores. (It is a vertical cylindrical unit with a number of superimposed hearths which are provided with rotating rabbles or rakes. It can be heated by a number of means. The ore is charged to the uppermost 20-ft. diameter hearth (see drawing on page 63) where it is mainly dried and then, entering the furnace body, it begins a steady downward travel. Preheated, roasted, calcined, preliminarily reduced, it finally enters the reducing hearth. The rabbles have propelled the ore through the 10 or 11 upper floors where it is heated either by the hot spent reducing gases alone, or also as conditions require—by the burning of a part

• • • ***Ferdinand Eberstadt***

1943's promise is that CMP will be a comfortable fitting suit, not a strait-jacket.

of these gases (which still contain combustible constituents) on one of the upper floors of the Herreshoff furnace.

The reducing hearth is of rather ingenious design. Here the mineral is fed into V-shaped troughs across the bottom of which are narrow slots and reducing gas is blown through them against the light, powdered ore particles which are made to bubble by the impact of the gas. In fact the ore bed has assumed a state equivalent to fluidity and flows of its own accord along the slotted hearth. This method of propelling the charge assures the slow advance of the heavier and faster advance of the lighter particles and is nearly proportional to the degree of progressive reduction. The depth of the bed of ore upon the final reduction hearth can be varied so as to form from a trickle to a river of ore, but it is usually kept between 6 and 10 in. in depth.

Many inventors have tried to work their reduction process on a counter - current principle, i.e., the dropping of ore into a rising current of gas, but then, the heaviest constituent travels fastest and arrives incompletely reduced at the bottom of the furnace. In the Brassert - Cape process, the charge is constantly agitated by hot reducing gases keeping it in a state of near-fluidity and blowing it slowly toward the discharge end of the reduction unit. Gas locks are continually broken up by counter-rotating rabble arms, the travel of the ore is retarded, the particles turned over and over, always suspended in a hot reducing atmosphere. Finally the reduced material, the just - born iron grains reach a chute which feeds them into briquetting rolls to be compressed under a reducing atmosphere at 500 lb. per. sq. in. or more if a higher specific gravity is desired, into a sheet-like briquette. The finished material may run 85 to 90 per cent Fe, 5 to 7 per cent gangue, the remainder being oxides.

It is expected that the temperature of reduction is so adjusted as to permit an optimum reduction rate while keeping the temperature low enough to prevent fritting and sticking of the individual particles. The oxygen content may possibly be removed up to 90 per cent within a comparatively short time (20 to 40 min.) with gases high in hydrogen at the operating temperature of 1100 deg. F. using Eastern magnetic ores.

The reducing gas should therefore preferably be mainly hydrogen, and coke oven gas, reformed natural, or water gas can be used advantageously. It must be a gas with a maximum H_2/CO ratio and a minimum content of hydro-carbons, carbon dioxide and nitrogen. It is of major importance to remove sulphur, and the gas must be adequately purified and conditioned. It must pass through the burden at a temperature of 1100 deg. F. and it must be preheated to a temperature slightly above that. A large part of the product of most processes is a "sponge", a porous honeycombed product with incompletely reduced iron surrounding and covering the "gangue". The sponge oxidizes rapidly in air and has to be subjected to mechanical work to be moderately suited for technical purposes. Thus, "sponge iron" is not comparable with the "indirectly" produced iron and steel, either quantitatively or qualitatively.

The melting stock is uniquely obtained by compression of "nascent iron" into briquettes in a reducing atmosphere. Pressure of the briquetting machine can be adjusted to produce iron of most any density and shape, since the face of the nascent iron particle, i.e., the iron granule which has just been reduced from its ore, has considerable chemical and physical surface reactivity.

The facility with which the melting stock can be made in any shape and density (below a specific gravity of about 8), in preliminary small-scale experimentation, has naturally given rise to the idea that perhaps sheets or shapes may eventually be turned out directly from the unit. This idea seems like powder metallurgy gone "Kaiser," and not much attention is being given to it at the moment.

The Brassert-Cape process will undoubtedly run into considerable operational difficulties at first, for such seems to be the fate of all commercial size direct-reduction plants. Undoubtedly, the hydrogen reduction is far more promising than carbon reduction used in most other schemes. Only actual operation of the plant will prove its viability, and quality and cost will determine its adoption elsewhere. Having excellent Port Henry and Chateaugay concentrates, and available desulphurized coke oven gas at Warren, Republic is ideally fixed to give this scheme a limited whirl. General opinion is that the man-hours involved in the direct reduction will more than offset the fuel saving, and over-all cost may be several dollars a ton more than for pig iron.

Publicist Nitens in Excelsos

Whether the problem was steel, non-ferrous metals, aircraft, shipbuilding, medicine, post-war planning or the love cycle of barnacles, the one individual who in 1942 knew all and told all was Henry John Kaiser. While the impact of Kaiser industrially was of negligible proportions, his deification by the man in the street was one of the seminal developments of 1942. Mr. Kaiser, the man, is a most likeable individual, who has mellowed considerably from the rough and tumble days of contracting, and even within the past year has shifted from brash desk thumping and bellowing to speaking softly (and often) and carrying the big stick of implied support from the Boss Man himself.

While less than two years ago a bug-eyed interviewer for the San Francisco News described Kaiser as the publicity-shy Oaklander, the intervening years have seen his curious development into an administration foil for big business, and fervent adoption by politicians, many newspapers, *Time* and *Life* magazines, well-known columnists and other assorted trained seals, as a practical visionary dragging along a great mass of hopelessly moribund, reactionary and selfish industrialists involved in the war effort. Mr. Kaiser has become something of a fetish and seemingly no one dares to question even those statements that reach the zenith of illusion without risking being howled down as a reactionary with questionable motives or a subversive nincompoop.

Certain of Kaiser's subordinates, conscious of his careless weaving of apologs, describe his talking as a process of thinking out loud in the buckshot manner, to spur everyone to heights of effort. That, in itself might well be commendable if such thinking didn't always carry the implication that practically all other industrialists were ignorant, or unimaginative, or selfish, or disinclined to give all in support of the war effort. And, this writer finds it hard to understand how all-out war production is furthered by constantly lambasting the automobile industry for its past interest in business as usual, and then admiring Kaiser's lofty advice to them to immediately design, plan production and accumulate payments for automobiles deliverable in, say, 1945; or, by a succession of timed publicity gags that are entertaining but nonethe less enervating to all those inevitably sucked in; or, for all companies to sweat through priorities to fit their building plans into the common effort, and then have even such straight thinkers as Raymond Clapper admire Kaiser's heavy purchases of steel from a warehouse as a demonstration of initiative so sadly lacking in others. That was a jolt to some producers who had made the steel and were at that same time unable to finish certain of their own badly-needed projects through lack of steel priorities.

• • • *Labor*

Tactically more money and security, strategically a prominent place at management's table.

While the writer certainly has no desire to dwell on pediculous minutiae, it might be of some interest to see how Kaiser's statements jibe with the facts. Oddly enough Mr. Kaiser is inordinately proud of and frequently states that he was the first to put pneumatic tires on wheelbarrows. The sales records of rubber companies fail to verify that. And, frequently, Mr. Kaiser states that he does the impossible, and that everyone said that he couldn't build Boulder Dam. That must come as a surprise to the Army, which surveyed the site, and let the contracts, in which Mr. Kaiser participated to the extent of perhaps one-fifteenth.* The other fourteen-fifteenths is never heard from. (*See footnote page 58*).

One of the next big Kaiser splurges was magnesium. Fritz Hansgirg's process had had indifferent success in several foreign countries accompanied by fatal explosions, but any advice against Kaiser's adoption of the process was construed either as technical ignorance or the frenetic efforts of monopolists to protect their position. Kaiser purchased Hansgirg's patents for $750,000 and built at Permanente, Cal., an enormously costly and complex installation, which in due course had its several fatal explosions. And on various occasions it was startling to hear Kaiser state that he was as usual far ahead of schedule and had revolutionized the magnesium business when, at the same time Permanente wasn't even remotely meeting production promises, which in turn was having considerable delaying effect on the 1942 war effort. Through exercising great care, the danger of explosions at Permanente has been more recently minimized, and the magnesium dust from the reduction furnaces now is being quenched with natural gas rather than hydrogen. Permanente's raw

material no longer comes from the "unlimited" reserves at Luning, Nev., but is now dolomite from Salinus, Cal., which is mixed with sea water at Moss Landing. Since there is every indication that the large three-phase electric reduction furnaces will never approach production expectations, a small single-phase furnace is currently being experimented with to determine its suitability. Kaiser also is using the Salinus dolomite in a newer Pidgeon-process plant at Monteca, Cal., which is already partly in production, as are a number of other similar plants elsewhere in the country, which were built and are operated by companies never before in the magnesium business and apparently not publicity conscious.

As regards Kaiser's steel effort at Fontana, Cal., the overtones and ramifications are rather interesting. There seems to be a carefully nurtured popular illusion that the making of steel on the Pacific Coast is another demonstration of the Kaiser magic touch, whereas conventional steel makers considered such operation impossible. But that was never the real difference of opinion.

*The financial relationships among the various so-called "Six Companies" contractors are so complex and varied that the finger can't be put on any fixed percentage. In February, 1931, the following six contractors formed a corporation for the construction of Boulder Dam with an authorized capital of 80,000 shares to be subscribed and paid for at $100 a share or a total of $8,000,000. Of this amount $5,000,000 was paid in cash and subscribed as follows: Macdonald and Kahn, $1,000,000; Utah Construction, $1,000,000; Bechtel-Kaiser-Warren (combination), $1,500,000; Morrison-Knudsen Co., $500,000; J. F. Shea Co., $500,000; Pacific Bridge Co., $500,000. How much of the one and a half million Kaiser had is unknown but it is assumed to be a minor part originally. Later Bechtel sold part of his share to Kaiser on the original deal. Since Boulder Dam, the following additional contractors are commonly regarded as among the "Six Companies" group: W. A. Bechtel Co., Bechtel-McCone-Parsons Corp., General Construction Co., Henry J. Kaiser Co.

On subsequent projects, such as the San Francisco Bay bridge, the Bonneville Dam, the Oakland Broadway tunnel (which was a failure and which they quit without completing), Parker Dam, Pacific Naval Air Bases and more recently Permanente Cement plant, Permanente magnesium plant and the various shipyards, different combinations of the group have been represented in various shares. It seems generally assumed that Macdonald & Kahn and probably the Utah Construction Co. are the best financed and therefore have a larger share in most of the projects, financially. One of the group is manager and responsible operator on each project. In shipbuilding on the Pacific Coast at the present time, Bechtel-McCone-Parsons operate Cal-Ship at Los Angeles, W. A. Bechtel Co. operates Marinship at Sausilito, Henry J. Kaiser Co. operates four yards at Richmond and three yards at Portland. Two yards at Richmond are operated as the Permanente Metals Corp. and one yard at Portland is operated as the Oregon Shipbuilding Co. Kaiser is supposed to have eight or nine per cent in Cal-Ship and in Marinship and conversely Bechtel and probably others of the original group have shares in the Kaiser operations.

Steel has long been made on the Pacific Coast, based on a limited supply of local scrap and pig iron from Utah or from Sparrows Point, Md. The difference of opinion dealt with the feasibility of a California blast furnace to make pig iron there. And, while it may ease the gnawing inferiority complex of the California Chamber of Commerce, this writer certainly is still of the opinion that increasing the less photogenic Utah pig iron capacity (which is being done by U. S. Steel) is far more sensible, technically and economically as a war measure, than building a blast furnace in California.

Kaiser's Fontana mill will cost at least $55 million, of which $48 million is an RFC loan, and will consist of blast furnace, by-product coke ovens, open hearths and plate mill. Almost before the plant was above ground level, request for an additional $75 million was made for soaking pits, blooming and structural mill, a merchant mill, and several electric furnaces. Cost of engineering was probably in the neighborhood of $6 million and is currently practically completed. Some 4000 to 5000 people worked on the construction job and there is apparently an adequate pool of both skilled and unskilled labor.

The entire plant couldn't possibly be more conventional in design, the one unique feature being that construction makes provision for earthquakes. Some Los Angeles experts are in charge of design and have insisted on many features not generally agreed to by other engineers. The blast furnace will have a special structure supporting it, tied in at the mantle. Stoves are bolted down for this reason. The dust catcher has columns as large as have been used for smaller blast furnaces, with 12-in. H beams for diagonal bracing, and about 16 2½-in. diameter bolts per column. The open hearth building will have bays on back of the charging bay and there will be one along the pit side, both throughout the entire length, for earthquake bracing of the main structures. The cost of the earthquake protective installations is estimated at $2 million.

Kaiser keeps insisting that his schedules will as usual be met or bettered, i.e., pig iron in December, 1942, ingot in February, 1943, and plates in June, 1943. But nothing short of miraculous completion of many items will permit rated pig iron in February, ingots in August, and plates by the end of 1943. None the less, even though many other blast furnaces elsewhere in the country have or will go into blast with hardly a stick of publicity, Mr. Kaiser apparently had a big show all scheduled for the Fontana furnace on Dec. 22, with Nelson, considerable military gold braid, bands, bunting, ad infinitum. The plans apparently have quietly expired or have been delayed, either because Mr. Weiss of WPB has been unable to lift enough coke from someone to blow in with or it was decided that the lack of a casting machine might be rather embarrassing.

All the coal will be dragged clear from Utah, being five days in transit. The Utah coal, of course, is so on the verge of being coking quality that the long trip in the hot summer is certainly not going to facilitate subsequent coking. Becker combination ovens will be used for coking, designed to operate on blast furnace gas enriched with coke oven gas. The by-products and benzol plants are very far behind schedule.

The only ore now available is a little boil nearby of barely 3,000,000 tons, which is high in sulphur and deficient in alumina. The planned operation is to sinter 50 per cent of the ore which will give satisfactory sulphur. The ore available will hardly last a year, and it is generally assumed that once the plant is in operation it will be a matter of national interest to have ore assigned to it by some governmental agency. To some this means that the finger will be put on Harlan Bradt, who has about liquidated himself over the past few years to carry the option on Southern Pacific's Eagle Mountain iron ore, which is not far away. To others, it may mean also dragging the ore clear from Utah.

Stoves are of the Baily type, all welded. Something went wrong in grouting in bottoms and these bulge up in the center as much as 6 in. Shells are bolted down, and no provision was made for distributing stresses, so the inner platework has been considerably messed up in taking care of this.

The open hearth department will consist of four standard 1850-ton furnaces designed by Open Hearth Combustion Co. and constructed by Loftus Engineering Co.

The water system was either

• • • The third dimension: First the Axis dished it out — now they are going to get it. America's first planes were under-gunned and under-armored, but today's designs adequately handle anything the supermen fly.

UNIV. OF MICH.

neglected or lost in the shuffle, and it has recently developed that all waste must be taken care of on the premises, as an outside sewer connection might endanger surrounding fruit farm land. Water supply is limited to some 4200 gal. per min., whereas requirements at the start will total 27,000 gal. per min. Assuming 10 per cent average make-up, it is figured that the water supply will be ample. There will be no reservoir, as site conditions would require a complete concrete unit, or equivalent tight construction; the problem is what concentration will result in recirculation of the water so many times daily, and also how the temperature will build up. Therefore, it has been decided to use thickeners, settling units, cooling towers, etc., in profusion. This water system will cost some $2 million over that which would normally be required elsewhere.

As regards the orchards and vineyards surrounding the Fontana plant, *Life* Magazine in October so carefully pointed them out as another example of the Kaiser magic wand, whereas ignorant, unesthetic steel companies elsewhere had drab and dirty surroundings. It now appears that possible ruination of adjacent fruit lands at Fontana is causing no little concern.

No members of a tentative operating staff have been engaged as yet. It is expected that one or more Eastern steel companies will provide men for key positions.

One of the most recent of Kaiser extravaganzas was the dramatic hiring of New Yorkers for his Portland, Swan Island and Vancouver shipyards. Here again the newspapers pointed up the plan as Kaiser in action while others merely talked. To some, it did seem like a long trip, particularly in view of the labor still available in the Pacific area. The Kaiser New York office on Sept. 23 announced intention of recruiting 20,000 men as fast as they could get them. The first day they hired on their own hook, and reported to the newspapers at the end of the day that they had taken 1200. Actually, they had hired 305. The next two days they hired through the U. S. Employment Service. The Employment Service interviewed 7000 men and referred 4000 to the Kaiser office. Kaiser reported they took all the men referred, with less than 2 per cent rejection. However, the 4000 referred to Kaiser were never all interviewed by his office. After the two days, when 2400 had been signed up (including the 305 from the first day) the office stopped hiring. Notwithstanding, two months later Kaiser was quoted as saying that in 1943 about 20 per cent of his shipyard labor would be women, and that he might recruit some of them in the East.

Late in 1942 Kaiser whipped up a storm of argument with his insistence that the way to service a global war was for him to build thousands of enormous transport air planes. Established aircraft makers were to supply him with the plans and the engineers and the government would supply the money. Practically everyone that knew nothing about materials or aircraft chipped in their two-cents' worth in an obstinate delirium of talk totally deaf to every technical argument, but cooler heads to the tune of considerable ridicule finally decided the idea should go back in the oven to bake a little longer. The aircraft industry was just a little startled by it all, what with their not having enough material to cover bomber commitments. The industry's general attitude was that if the government wanted transport planes, small, large or super, the only thing required would be some orders and some priorities on materials. Kaiser's brash statements that he would build the planes à la assembly line in his shipways without using scarce materials is just one of those things best forgotten.

It is in shipbuilding that the Kaiser reputation is most firmly entrenched. His son Edgar at Portland and Clay Bedford at the Richmond yards are both young, energetic and ingenious builders willing to take chances and put on the pressure. Both the Oregon yard and the Richmond No. 2 yard have been consistently a shade ahead of Bethlehem's Fairfield yard in building time, with other yards straggling in the rear. However, there can be some question as to the advisability of skipping over half-finished ships on ways to concentrate on a trick assembly of a ship in 4½ days, which leads to the popular belief that such speed becomes general practice in Kaiser yards. Some day this desire for publicity is going to lead to the inevitable extreme of sub-assembling two halves, rolling them on the way and having a swarm of men weld them together in 5 min. About the only way for a competitor to beat such a launching time is to launch the way itself. As a matter of record, it should be noted that there is a persistent apocryphal story going the rounds that several of these speedy publicity ships need constant pumping to prevent them from sinking. They, of course, go through the same severe Maritime Commission inspection as all the others.

The current average building time in all the Kaiser yards is 43 days, notwithstanding news photos of a ship shooting hot off the way in a couple of days. Even the 43-day average is darn good, and will likely be shaded to even a lower bogey for all builders to approach. Kaiser sub-assembly and building methods are certainly not unique and in fact were copied from the Fairfield and the Western Pipe and Steel yards, with the exception of a recent Kaiser (Edgar, the son) development of continuously assembling an entire deck house and lifting it onto a ship. A lot of workmen are used in Kaiser yards and in sub-assembly, and costs and man-hours are relatively quite high. Early British orders and subsequent large Maritime Commission orders for standardized freighters, and the more than usual zip in the supervisory personnel, all contribute their share to the speed of Kaiser assembly. The lowest cost yard in the country is North Carolina Shipbuilding Co. at Newport News.

The Non-Ferrous Metals

While all-important steel reeled under the impact of War demands during the year, each of the non-ferrous metals passed through a succession of equally severe if less publicized crises. But, for some months now pressure in this area of the metals industry has progressively relaxed, primarily because ordnance specifications were boldly written down to realistic levels and new production facilities were expedited at a fairly satisfactory pace.

Details of developments in aluminum, magnesium, nickel and other non-ferrous metals are set forth on page 140. It might be of interest to point out that aluminum supply is currently keeping pace with urgent demands, with production up about 100 per cent over 1941. And, only by spreading its

organization out very thin, has the Aluminum Co. of America been able to carry through this mitosis. The Aluminum Co. alone practically completed in 1942 a $250,000,000 expansion program and with other privately-owned and government-financed plants in operation, the U. S. produced during the year more than 1,000,000,000 lb. of this light metal. When the peak of 1943 production is reached, there will be a capacity in this country to make about 2,100,000,000 lb. annually, which is some 63 per cent more than the aluminum production of the whole world in 1938, and is, probably, eight times as much of the vital warplane metal as is turned out in Japan. And, expansion of fabricating facilities is keeping pace. Forging output is now over 25 times what it was before the war with several steel companies doing some sub-contract forging. Production of castings has been multiplied over eleven times; extruded shapes and tubing, about nine times. In all, the Aluminum Co. is building or has built 21 major plant projects for the government and will operate them on lease. Some of these plants were put into operation in 1942 and all of them will be producing during 1943.

The Reynolds Metals Co. likewise opened up aluminum plants at Lister Hill, Ala., and at Longview, Wash. The alumina plant at Lister Hill, however, has not been able to supply sufficient raw material and has consistently been supplemented from the outside. This deficiency will soon be taken care of by construction of additional alumina capacity.

In that other critically important light metal, magnesium, the expansion has been enormous, with eight new plants going into production in 1942 and four more scheduled for completion in 1943. The bulk of magnesium production is primarily based on the electrolytic process, differing only in detail from the method used by Bunsen about 130 years ago. The two generally recognized modifications are the Dow brine or seawater process, long used in the U. S., and the English-German I. G. process introduced to this country in the sprawling Basic Magnesium plant now in fairly heavy production at Las Vegas, Nev.; Hansgirg's thermal reduction process at Permanente has questionable technical merit, while the new Pidgeon ferrosilicon process is popular because of its efficiency and the facility with which new units can be constructed. The even newer Electro-Metallurgical ferrosilicon process may prove even more satisfactory, although additional experience will be needed to determine relative positions. The Dow process probably has the lowest cost, although the Basic method and the new ferrosilicon procedures may give it a hard run. Certainly, by the end of 1943, the question of relative costs should be definitely established. Parenthetically it might be mentioned that an apparently very magnesium-rich 2800-ft. brine well has been drilled at Moab, Utah, but so far little interest has been evidenced as regards commercial exploitation.

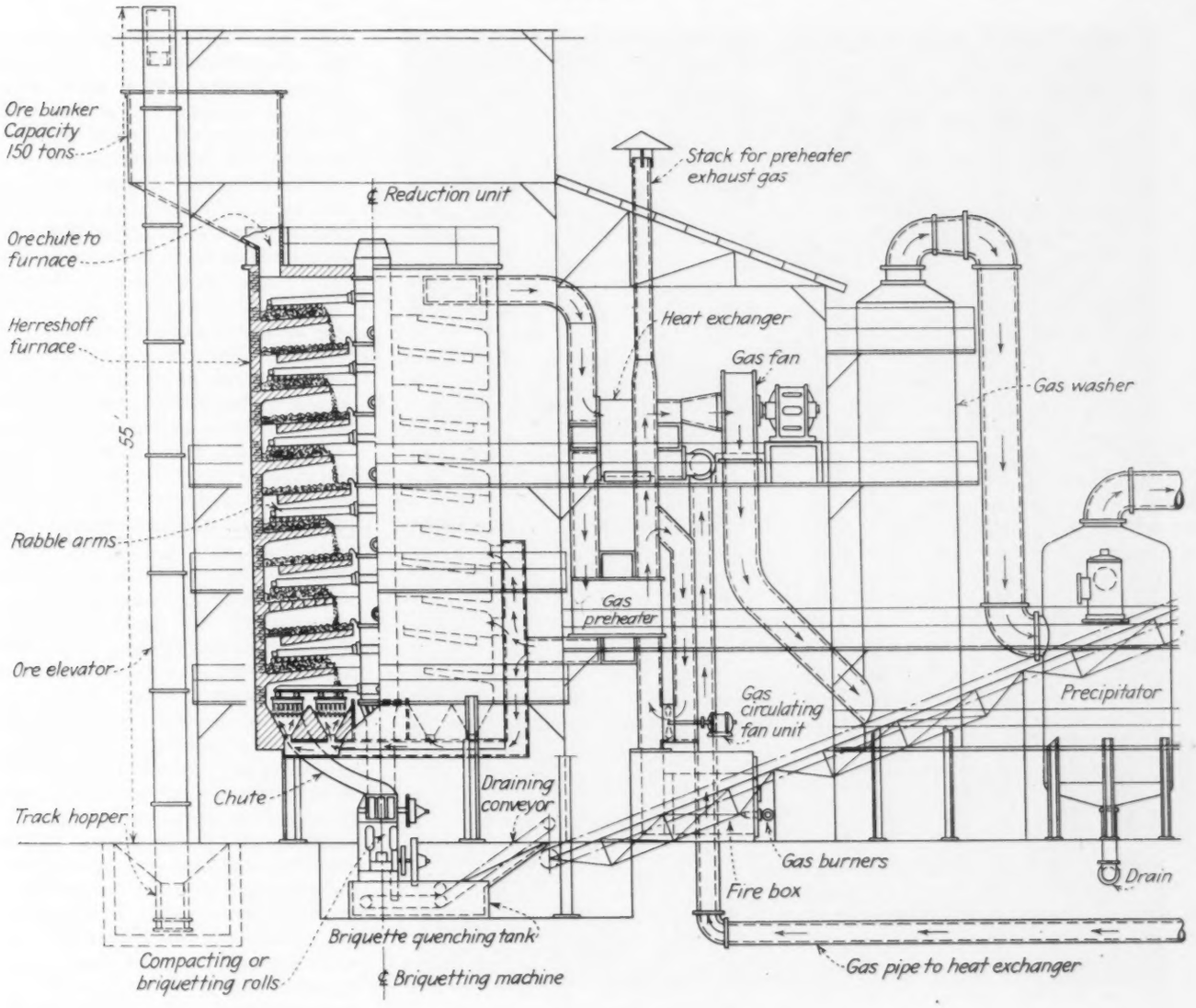
Nickel has dropped from an extremely critical to a comparatively easy position during the year, partly because some of the metallurgical load has been shifted onto molybdenum (which is probably in the toughest shape of any of the metals) and partly because alloy steel specifications have been written down into National Emergency (NE steels) specifications with considerably less nickel content, and numerous ordnance and armor plate specifications have likewise been altered with the same objective in mind. Tin is pretty tight, but this may be alleviated considerably by quite a sizable tin mining scheme which is in prospect for South Dakota. As regards the utilization of lower grade Western ores to improve the position of other metals, the record to date is rather spotty. A very excellent job has been done on vanadium in attracting small lots from small mines, and there is currently a huge stock pile at Moab, Utah. But, so far the exploitation of manganese and chromium deposits has been apparently unnecessarily inefficient and the position of both is none too comfortable.

The copper picture remains pretty bleak, with some estimates of 1943 requirements as much as 25 per cent ahead of 1943's maximum visible supply. Of course, the tremendous volume of brass shell cases needed for modern warfare is directly responsible for this excessive pressure on copper, and over 200,000 tons of the metal would be saved if the swing to steel cases even fractionally approached the rosy statements that have been emanating from the Ordnance Department over the past year.

The tremendous fire power of modern weapons drains off copper (brass) at a rate that simply can't be paced by the copper industry in any large country. Consequently, a shift to steel was apparent in a rather primitive form even in the last war, and has become grimly imperative in this war. The Germans for some time have used very large percentages of steel cases in all sizes and for both standard and high pressure projectiles. The Russians employ small quantities of steel, but are in no position to fully convert or experiment with the enemy hammering on the factory gate—for that reason large quantities of brass are shipped to them from this country, which in turn accelerates the need for shifting to steel in the U. S. German steel cases are made up of one, two, three, or even more components, and for the most part indicate clever and skilled integration of design, metallurgy and manufacturing technique.

In the U. S. the development work on steel cases has been characterized by backtracking, by no little amount of skilled but none the less overlapping and contradictory research, and by a pleasant volume of confident publicity releases. The attitude of the Ordnance Department has been somewhat like the attitude of certain individuals regarding cold showers on wintery mornings —they say it is easy; all that must be done is to take the resolution and the thing is done.

Even in mid-1942 certain War Department or Ordnance spokesmen were saying that a widespread shift to steel was imminent, a short time later General Motors, for one, waxed eloquent (with pictures) about their process, which is essentially the hot forging and drawing practice of Offut's in 1915, and by December Col. Turner of Ordnance indicated virtually 100 per cent changeover from brass to steel. It is true that revolver sizes are now almost completely changed to steel, and recently low-pressure 20 mm. and 75 mm. have changed to steel in large volumes. But for high pressure, high velocity cases in machine gun and artillery sizes —and use of armorplate in about everything is forcing many guns into the high pressure group—the



• • • Sponge Iron Without the Sponge

Well over 200 inventors have tried to return to the direct reduction method. This latest, the Brassert-Cape process for very low temperature reduction of iron ore to electric furnace melting stock, shows both metallurgical and mechanical promise. Both the degree of promise and at what cost will likely be put on the record by Republic by late 1943.

shift to steel has encountered more frustration than newspaper articles in the chiffon manner would indicate. The popular school of thought is that enough strength can be developed in steel cases by cold working to meet high pressure conditions, and there is no denying the practicability of this practice when alloy steel is used. Unfortunately, alloy steel is one of the scarcest of metals, and the use of carbon steel for the high pressure cases is a metallurgical and manufacturing problem far more elusive. A minority group favors carbon steel with heat treatment to secure the required strength and can demonstrate success, but so far to little avail. Whether it will be alloy steel with cold working, or carbon steel with heat treatment, necessity will have forced a decision by the end of 1943. As regards the two or three-piece cases employed so successfully by the Germans, the attitude of Ordnance so far has been far over on the disdainful side.

Wartime Technology

While some of the very interesting metallurgical and manufacturing developments, particularly those in light metals, are and likely will continue to be blanketed by censorship, there still are a number of innovations of which many are discussed in detail (see page 118) and others are of interest because of their long range implications.

Quite a few continuous liquid metal casting machines have gone, or will soon go into production, and have been particularly useful in turning out large volumes of flat rolling stock and extrusion sections in tricky non-ferrous alloys.

And, although attracting little or no attention, the phenomenal increase in extrusion capacity in this country over the past year has probably been of the order of 1000 or more per cent. Naturally this expansion is related to the multiplied aircraft program, and additional capacity will go on in 1943 to keep pace with further increases in aircraft assemblies. At present the largest press in the country is rated at 4000 tons, although 5000-ton presses are being built. Large

transport planes, or even the very large bombers, might well encourage the design of presses up to 20,000 tons pressure—that is, if there is not a concerted shift over to stainless or other alloy steels to avoid using such bulky extrusions. Budd Co. will very soon be turning out large stainless cargo planes at its new plant, and some of the new extra heavy bombers are going to employ large stainless wing sections. This might well initiate a partial shift to ferrous alloys, particularly for the heavy planes.

Extrusion of ferrous alloys in this country, on the other hand, is attracting little attention. Some stainless boiler tubes have been extruded, but nothing is planned comparable with the enormous machine in Scotland that takes an 80-ton ferrous ingot and extrudes torpedo tubes.

From aluminum engineers and scientists have come new developments such as a new lighter and stronger alloy, and a process for producing forged aluminum cylinder heads for aircraft engines. New and improved methods of fabricating aluminum have been developed, such as brazing, which has now reached a point where it is being extensively used in the construction of many light weight assemblies, whereas the application of spot welding may no longer be considered entirely experimental insofar as aircraft work is concerned. New chemical and electro-chemical finishes as well as synthetic resin coatings, have been perfected and applied to aircraft and other military equipment.

In ferrous metallurgy the well documented evolution of low-alloy steels has been an extremely praiseworthy example of practical and aggressive metallurgy. This, plus the construction of large blocks of electric furnace capacity, will be the steel industry's ace in the hole for the post-war battle with light metals that so many editorialists prophesy so freely. Another noteworthy metallurgical innovation of the year was the widespread utilization of the new boron-containing alloying agents or intensifiers for greatly increasing hardenability. The effect is not confined to merely a few grades of steel, but includes the carbon and alloy carburizing grades, the semi-hardening alloys and the new NE low alloy steels. At high hardness, the ductility and toughness are very good in these treated steels, and in the lower hardness ranges the mass benefits are such as to permit simplification in quenching and higher tempering temperatures with consequent reduction in distortion and cracking.

Production-wise, the adoption by the steel industry of the so-called triplexing technique of the steel foundry will be one of the year's most interesting developments if for no other reason than it will accelerate the flow of high grade metallics to the large numbers of electric furnaces coming into production. It has already been mentioned that Copperweld is about ready to utilize such a technique, and Laclede Steel Co. likewise has a similar set-up. All-told, perhaps a total of eight or nine installations of this type are going in. And, naturally, Republic's direct-reduction scheme will be followed with the sharpest of interest. In finished steel, electrolytic tinplate has become firmly entrenched, and plymetal technique such as those employed by Superior, Follansbee, and others, will undoubtedly have considerable post-war utilization in the highly competitive field of consumer products.

Labor Fights for Power

Even though 1942 has, in general, seen production and consumption of metals belatedly brought within the same framework, and technology has been equal to its new, strange and multiplied tasks, the far more serious problem of labor has probably deteriorated somewhat.

The deterioration regarding quantity became an increasingly popular conversational piece toward the end of 1942, whereas the very intimately related and far more insidious deterioration qualitatively is very deep-seated, verges on the enigmatic, and has been accorded relatively little attention. This qualitative factor finds its expression in the current terrible wastage of manpower, so very obvious in most mushrooming war plants, but still apparent to a somewhat lesser degree even in numerous long established plants. Many complex and interlaced motives generate this wastage.

Labor, of course, is a term that rolls off all tongues with beautiful facility, that conjures visions of a large, almost ominously sub-human, and inanimate mass, which like a commodity may be handled, molded, bought, sold, stocked, shipped, etc. Those who use the term "labor" practically never consider themselves as labor, and it is a curious fact that individual workers who certainly are of that group will themselves read or talk of the labor problem without in any way associating themselves with the problem. "Labor" is millions of men with sons fighting and dying in the army, somewhat uneasy when suddenly glutted by an afflux of work and wages, with wives squawking about rising costs of living and fearing for the future feeding and clothing of Junior, with illy formed but none the less frightening visions of a possible post-war kicking around.

To those with the sadistic aberrations of Westbrook Pegler, labor is an inarticulate mass of morons being led to ruin by a coterie of sinister crooks; to the suburban housewife who spent the day hijacking luxury foods out of tradesmen for a dinner party, labor is traitorously unpatriotic and rolling in dough, and should do such-and-so or otherwise be banished to the front; to the conservative, labor is overdue for a come-down to be promptly administered by the new Congress and even a "better" Congress to follow; to the industrialist, labor is something constantly upsetting production, breaking promises, demanding this and that, responsible for nothing and criticizing everything, and pushing and shoving its way into management's province; to many industrial relation experts, labor is some pliable material to be molded and shaped with slogans, patriotic shows, flossy house organs, efficiency presentations, service jewelry, paternalism, etc.; to the so-called realistic onlooker, labor is perhaps understandably but none the less dangerously defending all prerogatives and clutching for new ones, and unfortunately grafting peacetime featherbedding onto a war economy.

On the other hand, management is frequently painted as a grasping integrated organism, setting self-interest before the country's interests, unimaginative technically, and fearful of the industrial and social future, evading and circumventing taxes to salt away plenty of today's easy money, and ever striving to wipe out social gains and return

the economy to a loaded-dice laissez faire. But management on the whole is a bunch of harried individuals, pretty punch-drunk with the task of interchanging a peacetime with a wartime economy, resentful of many of the uninformed, distorted or untrue accusations bandied about by politicians and labor spokesmen, a little weary of being forever set up as a straw man to be bowled over, and wracked by their own fears of a post-war shellacking.

And, squeezed between is the so-called white collar class, inarticulate but habitually sympathetic with management, but lately alienated somewhat by indifferent wage adjustments. In addition, many office workers are shifting over into plant jobs, and are developing either the labor psychology, or at least acquiring sympathy for labor's aspirations. Furthermore, the flood of women into war work will bring its own future complications, some of which perhaps cancel each other. On the one hand, some women hitherto strangers to the industrial world are themselves developing a worker consciousness and sympathy, whereas the same women, or others, are impatient of much of labor's "talkee-talkee" and particularly critical of the loafing and gold bricking so frequently interfering with both the quality and quantity of war production. How certain shifting sympathies of white collar workers and the awakened sympathies of women will influence future events only the future will show.

In any case the extremists in both labor and management usually set the patterns for their respective groups, and each (farmers, also) is maneuvering for a position of sufficient dominance to better ride out the post-war storm. This basic distrust of each group for the other as regards ability or motives is of disturbing malignancy, and has its multitude of politico-economic ramifications and discordant social forces that has so bedevilled this generation into never-ending liberty vs. security arguments and the maturing of economic totalitarianism on both the right and left. In the U. S. the shock of large casualty lists and subsequent humility may develop the need for some re-ordering of thought by everyone to visualize some set of checks and balances that will take cognizance of the realities of an industrial society and will prepare for future events and contingencies by defining the status and functions of the individual in such a society.

• • • *Women*

Some are better than men; many are impatient with male soldiering and union shenanigans. Still others, previously alien to the work-a-day world, are developing sympathy with labor's aspirations. Photo by Richie for Allis-Chalmers.

The ridiculed groping of Henry Wallace and his quart of milk a day is probably not one of the tarnished come-ons of totalitarian dynamism, but is extremely naive or rudimentary awareness of social responsibility that has been tackled so elaborately in the British Beveridge Plan—a plan that conservatives in this country casually dismiss with a wave of their hands. The American counterpart to this plan will soon be trotted out by the National Resources Planning Board and its objectives will likely outdo Beveridge in laying down specific governmental responsibilities for the individual but endeavoring to escape the pitfalls of the socialistic or fascistic elimination of the creative spirit of private enterprise.

But these plans, long in genesis and longer in fruition, have little bearing on the current talk of yanking grandmother from the chimney corner to manhandle a turret lathe, while at the same time it is the labor that is being wasted that is so quickly screwing the supply problem up to a climax. In innumerable plants even the most casual observa-

tion shows stalling, duplication and unnecessary jobs in profusion, and sometimes the situation is so obnoxious that workers themselves are baffled and uneasy. Even more serious is the way in which foremen have lost all vestiges of authority and in fact are in danger of losing their jobs if some objection or instruction of theirs leads to the slightest labor - management friction. And, there is the related problem of supervisory personnel being spread so thin, or elevated so quickly as to be totally incapable of intelligent effort. And, there are those plants in which management itself seems to encourage worker inefficiency and for some obtuse reason actually resents anything that might lead to greater production.

Production suffers also in those plants wherein labor sees management operating in wasteful or selfish fashion, or concentrating in gouging as much out of the war effort as the traffic will bear. All these, together with maintenance of short work-weeks by unions, add up to a total drain on manpower that overshadows such drastic dislocations inherent in the possible plans of drafting women into mills and resorting to child labor.

It would seem that a great amount of the wastage could be corrected by the efforts of some unbiased governmental commission of recognized repute. And, instead of searching or actually inventing a mote in management's eye while absolutely refusing to even acknowledge theoretically a mote in labor's eye, labor leaders themselves could really enhance their prestige by washing out some of their own sins, instead of forever putting the onus on management for the purpose of forcing a place at management's table. In this latter category may be classed the recent elaborate presentation by the CIO to a Senate committee purporting to show practically criminal technical practices by the U. S. Steel Corp. and Republic in the manufacture of tank armor plate. This typical labor attack is just another effort to goad steel companies into a public spitting match in which the latter never display much skill, and to demonstrate to the public labor's management ability and skill in technical analysis, contains the usual serious and defaming accusations without apparent fear of retribution and categorically disposes of a technical problem in which certain basic facts are wrong and complexities are completely overlooked due to lack of knowledge. The report casually publicizes technical data on light armor plate that censorship has consistently kept out of all papers for the past year; points out the severe drains on nickel but at the same time is filled with innuendo regarding the motives of International Nickel in influencing retention of nickel in certain armor plate to maintain sales. And, the report keeps harping on the inexcusable waste of nickel and molybdenum without in any way examining the varieties of armor plate that must be made for various applications, whether it is to be welded or not, or how the WPB has to parcel out available supplies of nickel, molybdenum, manganese and ferrosilicon into an integrated and realistic armor plate program.

Perhaps more awareness to basic facts and intertwined technical complexities, and some degree of chastening, may come to the CIO when once it gets to the management table. One demonstration of this may come from Washington where H. J. Ruttenberg, former research director of the CIO, has recently become a member of the Production Directive Committee of WPB's Iron and Steel Division. Mr. Ruttenberg, a man of no mean ability, may recede from some of his hastily arrived at decisions, once he is on the inside looking out, and the CIO may be less inclined to lay down neat and biased manifestoes on the problems besetting steel production and distribution.

Craps vs. Econometrics

The emotional impasse of labor and management has, as already mentioned, a variety of politico-economic overtones. On the right is the school of thought that is apparently confident that winning the war will revive the so-called capitalistic system with the new blood of full production, while on the left are those who see in the full production and multiplied facilities the final undermining of private enterprise. Certainly the current supreme industrial effort is unique in that it is shot through and through with nagging uneasiness regarding post-war functioning of industrial society, both domestically and world-wide. The most lowly laboring man, the farmer, the industrialist, and even the theorist, have certain hopes and aspirations, but the latter is far ahead of all the others in blocking out the outlines of the future. Right today the theorists are laying plans that will have far more post-war influence than any of the winter military campaigns.

Doubtless very few people are conscious of the growing cult of econometrics, whereby the politico-economic organism is X-rayed by intricate mathematical - statistical formulae for the expressed purpose of controlling booms, offsetting and shortening depressions, and in fact charting long-range efforts that may have the most drastic influence on the life and economy of the country's least citizen. During the period of New Deal pump-priming and social innovations, econometrics expanded from casual verbal analyses into the use of rudimentary algebraic blueprinting of economic strains and stresses. More lately, the so-called science has adopted extremely intricate mathematical techniques, so intricate, in fact, that very few can follow through the reasoning. For that matter, there have been accusations that the extreme overcomplication is deliberately employed to over-awe opponents or to prove a point with questionable data without fear of refutation.

The granddaddy of econometrics is the toothy Briton, John Maynard Keynes, who spawned New Deal theory. Hanson, of Harvard University, Economic Advisor to Federal Reserve Board, and author of the recent book "Fiscal Policy and the Business Cycle," is leader of the American wing of the Keynes group, and he has placed his best students in key jobs all through Washington. They all meet weekly, read papers to each other, and will gang up on any outsider who employes the same technique and data to prove an opposite point. An important figure in this younger group is Lauchlin Currie, of the Federal Reserve, who is one of the six anonymous advisers to President Roosevelt and recently in China as Economic Advisor, who by moving in the inner circle exerts tremendous influence on policy. Currie is the protegé of Irving Fisher of Yale, the latter an able mathematician and conventionally conservative with the exception of aberrations in the field of money, which were tried out and exhausted in '33 and '34 during New Deal manipulations with currency. Stuart Chase is the popu-

lar writer under the Hanson wing, and is used to float trial balloons. Chase's technique is rather sloppy, and in the end he may be disowned by the perfectionists under Hanson. Offshoots from this group are sophisticated guys like Charles F. Roos, the practitioner, author of the book "Dynamic Economics," who for a fee in the thousands of dollars will give an interview or deliver himself of an opinion regarding any subject the client may suggest, whether it be the future prospects of the automobile industry, the alloy steel status in 1950, or adjusted seasonal trends in corn pad sales. Roos is never embarrassed when his analyses fall flat, but calmly points out that factors were influencing the problem of which he had no knowledge. The more prominent theorists in this galaxy are Gardner C. Means, who is the able mathematical mind ruling the activities of the National Resources Planning Board; and Mordecai Ezekial, the very able statistician and mathematician, albeit perhaps phoney economist, that rules the planning emanating from the Department of Agriculture, and very lately shifted to WPB. The Bureau of Labor Statistics has its own planners, and Paradiso, over in Jesse Jones' Department of Commerce, may be somewhat of a turncoat; for Paradiso may use the same data and technique to uncover a path to the political right in furtherance of Jesse Jones' embryonic presidential ambitions, whereas most of the others find the path leftward more attractive.

What does this powerful clique moving behind the scenes have to do with industry or the individual worker? They will exert tremendous influence on current planning for the post-war social and business reconstruction, and the extent with which their plans are accepted or watered down by others will determine the endurance of peace.

Therefore, the stage is pretty well set with extreme conservatives on one hand viewing business cycles as inevitable and prosperity a crapshooting adventure, and disciples of econometrics eliminating the cul-de-sac with the credo that business fluctuations are as controllable as a fractious child once they are properly house-broken. As already mentioned, the National Resources Planning Board will probably soon launch a long range social plan that will out-Beveridge Britain's Beveridge plan. In it there will certainly be an expanded social security program and increased government responsibility for the health, feeding, housing and education of the individual. Withal, provision will be made or at least promised for encouragement of private initiative. Only future developments will disclose whether the plan will so emphasize the absolute right to put all the phases of the blueprint into operation regardless of the costs to individual freedom which is the moral basis of totalitarianism—if so, it will stumble into the same pitfall of all modern planning and reforming.

The serious basic weakness underlying the science of econometrics is that the projections are made by desk men who have no functional approach to the industries they analyze. The tabular approach to industry can frequently be very foolish and often can lead to weird correlations, and if extrapolations are made based on these correlations the result can well be disastrous. And when multiple correlations are used without extremely intimate contact with an industry, errors can easily be distorted terribly, again with disastrous results.

As a theoretical example of these possibilities, say that a correlation were obtained between workmen's overalls and industrial production, and long range estimates were made on this basis. But, today, women are flooding into plants and the originator of the trend curve belatedly discovers that smocks, or slacks should have been incorporated into his basic data. Even more serious might the error be if the curve were originally based on multiple correlations. For instance, industrial activity correlated with workmen's overalls, buttons on overalls, yards of denim fabric, etc., etc. Here the errors multiply each other, with possibilities for fantastic errors. This example may be classed as a reductio ad absurdum, but none the less has its serious counterparts in legitimate industrial surveys that have been published.

The steel industry is still very conscious of the Paradiso-Means report of several years ago which linked the future demand for steel with national income and demanded immediate expansion of capacity. Now that the industry can't supply all the steel demanded by war industries, there are no end of belittling comparisons drawn regarding the foresight of conservative business and that of the top flight Washington planners. But, only accidentally does the present need for steel coincide with the Paradiso-Means prophesy of the need for steel—for they used national income as their basic data, and national income today has no relation whatsoever with steel demand. Currently, to name just one of the many analytical projects in the fire, the Bureau of Labor Statistics is laboriously working up intricate correlations between what every industrial group bought from or sold to every other industrial group in 1939. Not only is much of the basic data used rather of the guesswork type, but the startling idea is that possibly all the industries could be brought back to approximately the same relationship after the war.

In the immediate present, as Truman Arnold says, "There isn't the slightest evidence that tightly controlled labor organizations or industrial organizations or farm organizations are willing to turn their economic future over to the National Resources Planning Board." Nonetheless the war will progressively pile financial, production and social problems on top of each other in such profusion that the followers of econometrics will have the most attractive, if not the only, so-called solution to all difficulties. And, with the Government so heavily entrenched in production enterprises there will naturally be a desire to protect those enterprises, which immediately demands protection and control of domestic markets, and inevitably drags in the State Department for the protection and control of foreign markets.

How well or idealistically this problem is rationalized, how well the dominant political forces in the post-war period evolve a balance of power along the line of "limited risk," which likely will triumph over totalitarian dynamism, will determine just how enduring will be the final peace. Certainly, if the problems are not attacked with a little less selfishness and bigotry than so far has been demonstrated, there is every probability that the War Department can retain the current overrun on its form letter for redating in, say, 1975—the letter which starts off, "The Secretary of War desires to express his deep regret that your son was killed in defense of his country, in . . ."

E is for Excellence

CREDIT where credit is due. Here are the winners of the coveted Army-Navy E award, presented to industrial firms in recognition of outstanding performance on war work!

More than 500 companies have won the prize on the basis of performance since the joint award was established in the middle of 1942. Each is deserved. Each is passed upon by a board of officers and civilians after weighing the war contribution of each plant which is a candidate. Universally, the recognition results from hard work by the employees and officials of the firm.

The production award also is a symbol of the unity between the Armed Forces and the Production Forces, unity which will give the United Nations victory.

Although the awards have been listed previously as they were announced, THE IRON AGE is happy to publish the recapitulation below, covering the joint awards to early December, when it was necessary to put this section of the magazine to press.

Each of the firms selected is permitted to fly the Army-Navy Production Award pennant, pictured on the opposite page.

Final selection of Army-Navy award recipients on the part of the Navy is made by the Navy Board for Production Awards. This Board under authority of James V. Forrestal, Under Secretary of the Navy, includes: Admiral H. A. Wiley, U.S.N. (Retired); Rear Admiral George H. Rock (C.C.), U.S.N. (Retired); Rear Admiral W. T. Cluverius, U.S.N. (Retired); and Captain Frank Loftin, U.S.N. (Retired), Secretary.

The Army Board for Production Awards, appointed by Robert P. Patterson, Under Secretary of War, includes: Lieutenant General William S. Knudsen, Director of Production, Chairman; Major General Charles M. Wesson, former Chief of Ordnance; Brigadier General Bennet E. Meyers, Executive Officer, Material Command, Air Forces; Edward F. McGrady, Special Consultant to the Secretary of War; A. R. Glancy, Chief of Production Division, Headquarters, Services of Supply; and J. E. Harrell, Civilian Personnel Division, Services of Supply, Recorder.

A

A. C. Spark Plug Division, General Motors Corp., Flint, Mich.
A. O. G. Corp., The, Providence, R. I.
Abbott Laboratories, North Chicago, Ill., and New York, N. Y.
Aberfolye, Inc., Norfolk, Va.
Abott Fluorescent Co., Inc., New York
Abrasive Machine Tool Co., East Providence, R. I.
Accurate Brass Co., Inc., Glendale, Long Island, N. Y.
Acme Die & Machine Co., Inc., Latrobe, Pa.
Acushnet Process Co., New Bedford, Mass.
Aerco Corp., Hollydale, Calif.
Aetna-Standard Engineering Co., Ellwood City, Pa.
Aircraft Accessories Corp., Kansas City, Kans.
Aircraft Radio Corp., Boonton, N. J.
Airtemp Division, Chrysler Corp., Dayton, Ohio
Air-Track Mfg. Corp., College Park, Md.
Aldon Products Co., Duncannon, Pa.
Allegheny Ludlum Steel Corp., Brackenridge, Pa., and Watervliet, N. Y.
Allen Co., Charles C., Barre, Mass.
Alliance Machine Co., Alliance, Ohio
Aluminum Co. of America, Niagara Falls, N. Y.
Aluminum Co. of America, Die Casting Div., Garwood, N. J.
Aluminum Industries, Inc. (Plant No. 1), Cincinnati
Aluminum Ore Co., Aluminum Co. of America, Mobile, Ala.
American Bearing Corp., Indianapolis
American Brake Shoe & Foundry Co., Upset Plant, American Forge Division, Chicago
American Brass Co., Buffalo, N. Y.
American Lava Corp., Chattanooga, Tenn.
American Locomotive Co., Schenectady, N. Y.
American Machine & Metals, Inc., East Moline, Ill.
American Optical Co., Southbridge, Mass.
American Red Cross Blood Donor Service
American Rolling Mill Co., Zanesville Plant, Butler Plant, East Works, Central Works, Hamilton Plant, Ashland Plant
American Smelting & Refining Co., Hayden, Ariz.
American Tool Works Co., Cincinnati
American Welding Co., Carbondale, Pa.
American Zinc Co. of Illinois, Monsanto, Ill.
Ames Co., W. R., San Francisco
Ames Iron Works, Oswego, N. Y.
Anderson Mfg. Co., Albert & J. M., Boston
Ansonia Mfg. Co., Ansonia, Conn.
Arcos Corp., Philadelphia
Armstrong Bros. Tool Co., Chicago
Armstrong Cork Co., Lancaster, Pa.
Athenia Steel Co., Division of National Standard Co., Clifton, N. J.
Atlantic Mfg. Co., Philadelphia
Atlas Powder Co., Weldon Spring Ordnance Works, Weldon Spring, Mo.
Atlas Press Co., Kalamazoo, Mich.
Atwood Machine Co., Stonington, Conn.
Auto Ordnance Corp., Bridgeport, Conn.
Auto Specialties Mfg. Co., St. Joseph, Mich.
Automatic Machine Products Co., Attleboro
Aviation Corp., Lycoming Division, Williamsport, Pa.
Axelson Mfg. Co., Los Angeles

B

Bakewell Mfg. Co., Los Angeles
Barbour Stockwell Co., Cambridge, Mass.
Barium Reduction Corp., South Charleston, W. Va.
Barnes Co., W. F. & John, Rockford, Ill.
Wallace Barnes Co., Division of Associated Spring Corp., Bristol, Conn.
Barrett & Hilp, Mare Island Navy Yd., Mare Island, Calif.
Bauer Brothers Co., Springfield, Ohio
Beaumont Mfg. Co., Spartanburg, S. C.
Beech Aircraft Corp., Wichita, Kans.
Bell Aircraft Corp., Buffalo, and Niagara Falls, N. Y.
Bell & Howell Co., Chicago
Bell Telephone Laboratories, New York
Belle Knitting Corp., Sayre, Pa.
Belmont Radio Corp., Chicago
Bendix Aviation Corp., Eclipse-Pioneer Division, Bendix, N. J., and Philadelphia
Bendix Aviation Corp., Eclipse Machine Division, Elmira Heights, N. Y.
Bendix Aviation Corp. (Bendix Radio Div.), Baltimore
Benson Mfg. Co., Kansas City, Mo.

ARMY
E
NAVY

Berg Boat Co., Georgetown, Md.
Bethlehem Steel Co., Shipbuilding Div., San Francisco
Bethlehem Steel Co., Sparrows Point, Md.
Blanchard Machine Co., Cambridge, Mass.
Blaw-Knox Co., Union Steel Castings Div., Pittsburgh
Bliley Electric Co., Erie, Pa.
Bloomsburg Mills, Inc., Bloomsburg, Pa.; Lockhaven, Pa.
Boeing Airplane Co., Seattle, Wash.
Boeing Airplane Co., Wichita Division, Wichita, Kans.
Bonney Forge & Tool Works, Allentown, Pa.
Boonton Molding Co., Boonton, N. J.
Boott Mills, Lowell, Mass.
William R. Bootz Mfg. Co., Evansville, Ind.
Borg-Warner Corp. (Spring Division) Bellwood, Ill.
Bound Brook Oil-Less Bearing Co., Bound Brook, N. J.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Boyt Harness Co., Des Moines, Iowa
Brann & Stuart, Inc., Mechanicsburg, Pa.
Briggs Mfg. Co. (Conner Plant) Detroit
Briggs & Stratton Corp. (West Plant) Milwaukee
Brunner Mfg. Co., Utica, N. Y.
Bryant Chucking Grinder Co., Springfield, Vt.
Bucyrus Erie Co., South Milwaukee
Budd Wheel Co., Detroit
Buffalo Forge Co., Buffalo, N. Y.
Buffalo Pumps, Inc., North Tonawanda, N. Y.
Builders Iron Foundry, Providence
Bullard Co., Bridgeport, Conn.
Burgess-Norton Mfg. Co., Geneva, Ill.
Byron Jackson Co., Los Angeles

C

Cambridge Screw Co., Cambridge, Mass.
Camden Forge Co., Camden, N. J.
Carbide & Carbon Chemicals Corp., South Charleston, W. Va., plant
Carlton Machine Tool Co., Cincinnati
Carolina Aluminum Co., Aluminum Co. of America, Badin, N. C.
Century Machine Co., Cincinnati
Cessna Aircraft Co., Wichita, Kans.
Chain Belt Co., Milwaukee
Champion Pants Mfg. Co., Inc. (Royal Pants Co.), Perkasie, Pa.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Chatham Mfg. Co., Elkin, N. C.
Chemurgic Corp., Richmond, Calif.
Cheney Brothers, Manchester, Conn.
Chevrolet Gear & Axle Division, General Motors Corp., Detroit
Chromium Corp. of America, Chicago
Chrysler Corp. (Detroit Tank Arsenal), Centerline, Mich.
Chrysler Corp., Detroit, Mich.
Cincinnati Bickford Tool Co., Cincinnati
Cine Simplex Corp., Syracuse, N. Y.
Clarostat Mfg. Co., Inc., Brooklyn
Clayton Mfg. Co., Los Angeles
Climax Molybdenum Co., Climax, Colo., Langeloth, Pa., Detroit
Clinton Woolen Mfg. Co., Clinton, Mich.
Clyde Iron Works, Inc., Duluth
Collins Radio Co., Cedar Rapids, Ia.
Colorado Fuel & Iron Corp., Pueblo, Colo.
Colt's Patent Fire Arms Mfg. Co., three plants in Hartford, Conn.
Columbia Steel Co., Pittsburg, Calif.
Columbiana Boiler Co., Columbiana, Ohio
Commercial Shearing & Stamping Co., Youngstown
Cone Automatic Machine Co., Inc., Windsor, Vt.
Connecticut Telephone & Electric Corp., Meriden, Conn.
Consolidated Aircraft Corp., Plants 1 & 2, San Diego, Calif.
Continental Motors Corp., Detroit
Continental Roll & Steel Foundry, East Chicago Plant, East Chicago, Ind.
Contractors, Pacific Air Bases, Pearl Harbor, T. H.
Corbin Screw Corp., New Britain, Conn.
Couse Laboratories, Inc., Newark, N. J.
Cox Construction Co., Inc., P. T., and Spearin, Preston & Burrows, Newport, R. I.
Cramerton Mills (Cramerton Plant) Cramerton, N. C.
Crawford - Austin Mfg. Co., Waco, Texas
Crawford Mfg. Co., Richmond, Va.
Crowley & Co., H. L., West Orange, N. J.
Cummings Machine Works, Boston
Cunningham Son & Co., James, Rochester, N. Y.
Curtiss-Wright Corp., Airplane Division, Plants No. 1 and No. 2, Buffalo
Cushman Chuck Co., Hartford, Conn.

D

Delco Products Division, General Motors Corp., Dayton
Diamond T Motor Co., Chicago
Diebold Safe & Lock Co., Canton, Ohio
Disston & Sons, Inc., Henry, Philadelphia
Divine Bros, Utica, N. Y.
Doyle & Russell, Norfolk, Va.
Duiron Co., Inc., Dayton, Ohio
Dunn Construction Co. & Polk Smartt Paving Co., Millington, Tenn.
Duplex Printing Press Co., Battle Creek, Mich.
du Pont de Nemours & Co., E. I., Barksdale, Martinsville & Seaford Plants
du Pont de Nemours, Inc., E. I., (Chickasaw Ordnance Works) Millington, Tenn.
du Pont de Nemours & Co., E. I., Electro Chemicals Plant, & Niagara Falls Plant, Niagara Falls
du Pont de Nemours & Co., E. I., (Indiana Ordnance Works) Charlestown, Ind.
du Pont de Nemours, Inc., E. I., (Kankakee Ordnance Works) Joliet, Ill.
du Pont de Nemours, Inc., E. I., Neoprene Plant, Deepwater, N. J.
du Pont de Nemours & Co., E. I., Nylon Laboratory, Wilmington, Del.
du Pont de Nemours & Co., E. I., Repaune Works, Gibbstown, N. J.

E

Eagan Co., Walter H., Philadelphia
Eastman Kodak Co. (Kodak Park Works, Camera Works, Hawk-Eye Works and Eastman Office) Rochester, N. Y.
Eaton Mfg. Co., Detroit
Eaton Metal Products Corp., A. N., Omaha, Neb.
Edgewater Steel Co., Oakmont, Pa.
Edgewood Chemical Warfare Arsenal, Edgewood, Md.
Edo Aircraft Corp., College Pt., N. Y.
Edward Co., Division of Rogers Diesel & Aircraft Corp., Sanford, N. C.
Eitel McCullough, Inc., San Bruno, Calif.
Electric Auto-Lite Co., Toledo, Ohio
Electric Boat Co., Elco Naval Div., Bayonne, N. J.
Electric Tachometer Corp., Philadelphia
Electro - Metallurgical Co., Niagara Falls, N. Y.
Electromaster, Inc., Detroit
Emerson Electric Mfg. Co., Booster Plant, St. Louis
Emerson Electric Mfg. Co., Turret Division, St. Louis County, Mo.
Erie City Iron Works, Erie, Pa.
Erie Proving Ground, La Carne, Ohio
Eureka Vacuum Cleaner Co., Gas Mask Div., Detroit
Ex-Cell-O Corp., Detroit

F

Fafnir Bearing Co., New Britain, Conn.
Fairchild Aviation Corp., Jamaica, N. Y.
Federal Mfg. & Engineering Corp., Brooklyn
Federal Motor Truck Co., Detroit
Federal Products Corp., Providence
Federal Screw Works, Plant No. 4, Chelsea, Mich.
Federal Shipbuilding & Dry Dock Co., Kearny, N. J.
Fellows Gear Shaper Co., Springfield, Vt.
Ferris Instrument Corp., Boonton, N. J.
Ferro Enamel Corp., Cleveland
Firestone Rubber & Latex Products Co., Fall River, Mass.
Firestone Tire & Rubber Co., Firestone Park Plant, Akron, Ohio
Fischer & Co., H. G., Chicago
Flannery Bolt Co., Bridgeville, Pa.
Fleetwood Craftsmen, Inc., Fleetwood, Pa.
Folmer Graflex Corp., Rochester, N. Y.
Food Machinery Corp., Lakeland, Fla.
Ford Motor Co., Chester, Pa.
Fosdick Machine Tool Co., Cincinnati
Fostoria Screw Co., Fostoria, Ohio
Foster Wheeler Corp., Dansville, N. Y., Plant
Frankford Arsenal, Philadelphia
Frigidaire Ordnance Plant, General Motors Corp., Dayton, Ohio

G

Gadsden Ordnance Plant, Gadsden, Ala.
Gaede Dyeing Co., Inc., Paterson, N. J.
Galvin Mfg. Co., Chicago
Gary Steel Products Corp., Norfolk, Va.
General Asbestos & Rubber Div. of Raybestos - Manhattan, Inc., North Charleston, S. C.
General Cable Corp., Perth Amboy, N. J., and Rome, N. Y.
General Machinery Corp., Hamilton, Ohio
General Machinery Corp., Lakeland, Fla.

General Machinery Ordnance Corp. (U. S. Navy Ordnance Plant), South Charleston, W. Va.
General Motors Corp., Allison Division, Indianapolis
General Motors Corp., Oldsmobile Division, Lansing, Mich.
General Motors Corp., Packard Electric Division, Warren, Ohio
General Motors Corp., Plant A, New Departure Div., Bristol, Conn., and Plant D, Meriden, Conn.
General Steel Castings Corp., Eddystone, Pa.
General Steel Castings Co., (Commonwealth Plant) Granite City, Ill.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gilbert & Barker Mfg. Co., West Springfield, Mass.
Gilfillan Brothers, Inc., Los Angeles
Gisholt Machine Co., Madison, Wis.
Gleason Works, Rochester, N. Y.
Goodrich Co., B. F., Akron, Ohio
Goodyear Engineering Corp., Hoosier Ordnance Plant, Charlestown, Ind.
Goodyear Tire & Rubber Co. (Plant No. 3) Akron, Ohio
Gray Planer Co., G. A., Cincinnati
Greenfield Tap & Die Corp., Greenfield, Mass.
Greenlee Brothers & Co., Rockford, Ill.
Greist Mfg. Co., New Haven, Conn.
Grimes Mfg. Co., Plant 1, Urbana, Ohio
Guide Lamp Division, General Motors Corp., Anderson, Ind.
Gundlach Mfg. Co., Fairport, N. Y.
Gurley, W. & L. E., Troy, N. Y.

H

Haines Gauge Co., Philadelphia
Hall-Scott Motor Car Co., Berkeley, Calif.
Hallicrafters Co., Chicago
Hammermill Paper Co., Erie, Pa.
Hampshire Woolen Co. and Ware Woolen Co., Ware, Mass.
Handy & Harman Co., Bridgeport, Conn.
Hanes Knitting Co., P. H., Winston-Salem, N. C.
Hanson-Whitney Machine Co., Hartford, Conn.
Harper Co., H. M., Chicago
Harrisburg Steel Corp.. Harrisburg, Pa.
Hayes Industries, Jackson, Mich.
Hazard Insulated Wire Work (Div. of Okonite Co.), Wilkes-Barre, Pa.
Heald Machine Co., Worcester, Mass.
Heintz Mfg. Co., Philadelphia
Hendy Iron Works, Joshua (Plant No. 2), Sunnyvale, Cal.
Heppenstall Co., Bridgeport, Conn.
Hercules Powder Co., Radford Ordnance Works, Radford, Va.
Hershey Chocolate Corp., Hershey, Pa.
High Standard Mfg. Co., New Haven, Conn.
Hilton-Davis Chemical Co., Cincinnati
Hobart Brothers Co., Troy, Ohio
Hobart Manufacturing Co., Troy, Ohio
Hoe & Co., Inc., R., Bronx, N. Y.
Homelite Corp., Port Chester, N. Y.
Hood Rubber Co., Division of B. F. Goodrich Co., Watertown, Mass.
Hooker Electro-Chemical Co., Niagara Falls, N. Y.
Humble Oil & Refining Co. (Baytown Ordnance Works) Baytown, Texas
Huntsville Chemical Warfare Arsenal, Huntsville, Ala.
Hyde & Sons Co., A. R., Cambridge, Mass.
Hyde Windlass Co., Bath, Me.

I

I-T-E Circuit Breaker Co., Philadelphia
Independent Lock Co., Fitchburg, Mass.
Independent Pneumatic Tool Co., Aurora, Ill.
Indium Corp. of America, Utica, N. Y.
Industrial Tool & Die Works, Inc., St. Paul, Minn.
Ingersoll Rand Co., Athens, Pa.
Ingersoll-Rand Co., Painted Post Plant, Painted Post, N. Y.
Ingersoll-Rand Co., Phillipsburg, N. J.
Inspiration Consolidated Copper Co., Inspiration, Ariz.
International Business Machines Corp. Plant Number 1, Endicott, N. Y.
International Flare Signal Division, Kilgore Mfg. Co., Tipp City, Ohio
International Harvester Co., Milwaukee
International Resistance Co., Philadelphia
International Smelting & Refining Co., Miami, Ariz.
Iowa Transmission Co., Waterloo, Iowa
Irving Subway Grating Co., Long Island City

J

Jacobs Co., F. L., Volute Spring Suspension Plant, Dearborn, Mich.
Jacobs Co., F. L., Detroit
Jacobson & Co., Inc., New York
Jefferson Proving Ground, Madison, Ind.
Jeffersonville Quartermaster Depot, Jeffersonville, Ind.
Jenkins Brothers, Inc., Bridgeport, Conn.
Jessop Steel Co., Washington, Pa.
Johnson & Johnson Gas Mask Division, Plants No. 1 and No. 2, Chicago
Johnson Steel & Wire Co., Worcester, Mass.
Jones & Lamson Machine Co., Springfield, Vt.

K

Kaltenbach Corp., & Wellman Engineering Corp., Cleveland
Kearney & Trecker Corp., Milwaukee, Wis.
Kellogg Co., Battle Creek, Mich.
Kelsey-Hayes Wheel Co., Plymouth, Mich.
Kemp Mfg. Co., C. M., Baltimore
Kendall Co., Bauer & Black Division, Chicago
Kennecott Copper Corp., Utah Copper Co., Bingham, Utah
Kennecott Corp., Nevada Consolidated Corp., Ray, Ariz.
Kennecott Wire & Cable Co., Phillipsdale, R. I.
Kent Mfg. Co., Clifton Heights, Pa.
Kilgore Mfg. Co., Westerville, Ohio
Kingsbury Machine Works, Inc., Philadelphia
Kollmorgen Optical Corp., Brooklyn, N. Y.
Kingston Products Corp., Kokomo, Ind.
Kraft Cheese Co., three plants
Krasberg & Sons Mfg. Co., R., Chicago

L

Lake State Products, Inc., Jackson, Mich.
Landis Machine Co. (M52 Fuse Plant), St. Louis
Landis Tool Co., Waynesboro, Pa.
Lapointe Machine Co., Hudson, Mass.
Lapp Insulator Co., Le Roy, N. Y.
LeBlond, R. K., Machine Co., Cincinnati
Leece-Neville Co. (2 plants), Cleveland
Leeds & Northrup Co., Philadelphia
Leland-Gifford Co., Worcester, Mass.
Lempco Products, Inc., Bedford, Ohio
Leslie Co., Lyndhurst, N. J.
Levingston Shipbuilding Co., Orange, Texas
Lidgerwood Mfg. Co., Elizabeth, N. J.
Lights, Inc., Alhambra, Calif.
Lincoln Engineering Co., St. Louis
Lincoln Mills of Alabama, Huntsville, Ala.
Lincoln Park Tool & Gage Co., Lincoln Park, Mich.
Linde Air Products Co., Sapphire Plant, East Chicago, Ind.
Lipe-Rollway Corp., Syracuse, N. Y.
Lundquist Tool & Mfg. Co., Worcester, Mass.

M

M. B. Mfg. Co., New Haven, Conn.
Macco Construction Co., San Diego, Calif.
Mack Mfg. Co., New Brunswick, N. J.
Macwhyte Co., Kenosha, Wisc.
Magma Copper Co., Superior, Ariz.
Manufacturers Machine & Tool Co., Inc., New York
Manville Mfg. Co., Pontiac, Mich.
Marchant Calculating Machine Co., Oakland, Calif.
Marquette Metal Products Co., Cleveland
Martin-Schwartz, Inc., Mill Street Plant, Salisbury, Md.
Mathews Cotton Mill, Greenwood, S. C.
Maxon Construction Co., Burns City, Ind.
McCord Radiator & Manufacturing Co. (Plant No. 1), Detroit
Meissner Mfg. Co., Mt. Carmel, Ill.
Mergenthaler Linotype Co., Brooklyn
Miami Copper Co., Miami, Ariz.
Miami Shipbuilding Corp., Miami, Fla.
Micromatic Hone Corp., Detroit
Middlesex Paper Tube Co., Burlington, N. J.
Miller Printing Machinery Co., Pittsburgh
Milwaukee Saddlery Co., Milwaukee
Minneapolis-Honeywell Regulator Co., South Minneapolis, Minn., and Wabash, Ind.
Monitor Piezo Products Co., South Pasadena, Calif.
Monroe Auto Equipment Co., Monroe, Mich.
Mount Vernon Die Casting Corp., Mount Vernon, N. Y.
Munsingwear, Inc., Minneapolis
Murray Mfg. Co., Brooklyn

N

National Automatic Tool Co., Richmond, Ind.
National Broach & Machine Co., Detroit

National Carbon Co., Clarksburg Plant, Clarksburg, W. Va.
National Fireworks, Inc., Memphis, Cordova, Tenn.
National Magnesium Corp., Elkton, Md.
National Pneumatic Co., Rahway Plant, Rahway, N. J.
National Tube Co., Christy Park Works, McKeesport, Pa.
National Twist Drill & Tool Co., Detroit
National Wire Die Co., New York
National Zinc Co., Bartlesville, Okla.
Naval Ammunition Depot, Fort Mifflin, Pa.
Naval Ammunition Depot, Hawthorne, Nev.
Naval Ammunition Depot, Iona Island, N. Y.
Navy Yard, Charleston, S. C.
Navy Yard, Pearl Harbor, T. H.
Navy Yard, Portsmouth, N. H.
Navy Yard, Puget Sound, Wash.
New Britain Machine Co., New Britain, Conn.
New Process Gear Co., Syracuse, N. Y.
W. H. Nichols & Sons, Waltham, Mass.
Norris Stamping & Mfg. Co., Los Angeles
North American Aviation, Inc., Inglewood, Calif., Dallas, Texas
Northern Engraving & Mfg. Co., La Crosse, Wisc.
Norwalk Co., Inc., South Norwalk, Conn.

O

O'Connor Machine Co., Sheffield, Pa.
Ohio Injector Co., Wadsworth, Ohio
Ohio Locomotive Crane Co., Bucyrus, Ohio
Omaha Steel Works, Omaha, Neb.
Oneida Limited, Oneida, N. Y.
Osgood Co., Marion, Ohio
Otis Elevator Co., Aeronautical Div., Harrison, N. J.
Otis Elevator Co., Yonkers, N. Y.
Owatonna Tool Co., Owatonna, Minn.
Owens-Corning Fiberglas Corp., Ashton, R. I., Newark, Ohio

P

Pacific Mills, Lawrence, Mass.
Parish Pressed Steel Co., Reading, Pa.
Pausin Engineering Co., Newark, N. J.
Peco Mfg. Co., Philadelphia
Phelps Dodge Corp., Morenci, Jerome and Ajo, Ariz.
Phelps Dodge Copper Products Corp., Bayway, N. J., Yonkers, N. Y., Fort Wayne, Ind., plants
Philadelphia Quartermaster Depot, Philadelphia
Philco Corp., Chicago Branch, Chicago
Philco Corp. (Storage Battery Div.), Chicago
Philco Corp., Philadelphia
Philco Corp. (Simplex Radio Corp.), Sandusky, Ohio
Picatinny Arsenal, Dover, N. J.
Picker X-Ray Corp., Cleveland
Pillsbury Flour Mills Co., Springfield, Ill.
Pioneer Parachute Co., Manchester, Conn.
Pittsburgh Forgings Co., Coraopolis, Pa.
H. K. Porter & Co., Pittsburgh
Powers & Co., Philadelphia
Pratt & Whitney Division, Niles-Bement-Pond Co., West Hartford
Pressed Steel Car Co., Inc., Chicago
Procter & Gamble Defense Corp., Wolf Creek Ordnance Plant, Milan, Tenn.
Proving Center, Aberdeen Proving Ground, Aberdeen, Md.
Putnam Tool Co., Detroit

R

RCA Mfg. Co., Radiotron Division, Harrison, N. J.
R. T. C. Shipbuilding Corp., Camden, N. J.
Radiomarine Corp. of America, New York
Read & Lovett Mfg. Co., Weatherly, Pa.
Redstone Ordnance Plant, Huntsville, Ala.
Reed-Prentice Corp., Worcester, Mass.
Regina Corp., Rahway, N. J.
Remington Arms Co., Inc. (Main Plant), Bridgeport, Conn.
Remington Arms Co., Denver Ordnance Plant, Denver
Remington Arms Co., Inc., Ilion, Works, Ilion, N. Y.
Remington Arms Co. (Lake City Ordnance Plant), Independence, Md.
Remler Co., Limited, San Francisco
Republic Mining & Mfg. Co., Aluminum Co. of America, Bauxite, Ark.
Revere Copper & Brass, Inc. (Chicago Div.), Chicago
Rheem Mfg. Co., Sparrows Point, Md.
Rieke Metal Products Corp., Auburn, Ind.
Ritter Co., Inc., Rochester, N. Y.
Rivett Lathe & Grinder, Inc., Boston
Robertshaw Thermostat Co., Youngwood, Pa.
W. A. Robinson, Inc., Ipswich, Mass.
Rock Island Arsenal, Rock Island, Ill.
Rogers Brothers Corp., Albion, Pa.
Ross Gear & Tool Co., Lafayette, Ind.
Ross-Meehan Foundries, Chattanooga, Tenn.
Rustless Iron & Steel Corp., Baltimore

S

Saginaw Steering Gear Division, General Motors Corp., Saginaw, Mich.
Frank L. Sample, Jr., Inc., Boothbay Harbor, Me.
Sangamo Electric Co., Springfield, Ill.
Savage Arms Co., Utica, N. Y.
Savage Arms Corp., Stevens Arms Co., River Plant, Chicopee Falls, Mass.
Savanna Ordnance Depot Number 2, Proving Ground, Ill.
Schauer Machine Co., Cincinnati
Schrader's Sons, A., Division of Scovill Mfg. Co., Inc., Brooklyn, N. Y.
Scott Aviation Corp., Lancaster, N. Y.
Scovill Mfg. Co., Waterbury, Conn.
Scripto Mfg. Co., Atlanta, Ga.
William Sellers & Co., Inc., Philadelphia
Semet-Solvay Co., Solvay, N. Y.
Service Corp., J. M., Kansas Ordnance Plant, Parsons, Kan.
Sharples Corp., Baltimore
Sheffield Corp., Dayton, Ohio
Ralph Shipman Co., Sunbury, Pa.
Shoe Lace Company, Lawrence, Mass.
Simmons Machine Tool Corp., Albany, N. Y.
Simplex Wire & Cable Co., Cambridge, Mass.
Simpson Optical Mfg. Co., Chicago
Singer Mfg. Co., Elizabethport, N. J.
Skinner Engine Co., Erie, Pa.
J. Sklar Mfg. Co., Long Island City, New York
Smith Co., A. O., Milwaukee
Snow-Nabstedt Gear Corp., New Haven, Conn.
Snow Shipyards, Inc., Rockland, Me.
Solar Aircraft Co., San Diego, Calif.
Solvay Process Co., Hopewell Plant, Hopewell, Va.
Southern Chemical Cotton Co., Inc., Chattanooga, Tenn.
Southwest Boat Corp., Southwest Harbor, Me.
Specialty Screw Machine Products Co., Lancaster, Pa.
Sperry Gyroscope Co., Inc., six plants, Long Island City, N. Y.
Spicer Mfg. Corp., Toledo, Ohio
Springfield Armory, Springfield, Mass.
E. R. Squibb & Sons, New York, New Brunswick, N. J., Brooklyn, N. Y.
Standard Bleachery & Printing Co., Carlton Hill, N. J.
Standard Gage Co., Inc., Poughkeepsie, N. Y.
Standard Piezo Co., Carlisle, Pa.
Star Electric Motor Co., Bloomfield, N. J.
Stewart Silk Corp., Easton, Pa.
Stewart-Warner Corp. (South Plant), Chicago
Stickle Steam Specialties Co., Indianapolis
J. L. Stifel & Sons, Inc., Wheeling
Stockham Pipe Fittings Co., Birmingham, Ala.
Streeter, Hackney & Co., Johnstown, N. Y.
Strontium Products Co., Chauncey, Ohio
Struthers Wells-Titusville Corp., Titusville, Pa.
Summerill Tubing Co., Bridgeport, Pa.
Suncook Mills, Suncook, N. H.
Sundstrand Machine Tool Co., Rockford, Ill.
Sunnen Productions Co., St. Louis
Supreme Knitting Machine Co., Brooklyn, N. Y.
Switlik Parachute Co., Trenton, N. J.
Sylvania Electric Products Inc., Emporium, Pa.

T

Tacoma Boat Building Co., Tacoma, Wash.
S. G. Taylor Chain Co., Hammond, Ind.
L. H. Terpening, New York
Texas Gulf Sulphur Co., Galveston and Newgulf, Texas
Timken-Detroit Axle Co., Waukegan, Ill., Detroit, Mich., and Oshkosh, Wis.
Titan Metal Mfg. Co., Bellefonte, Pa.
Titanine, Inc., Union, N. J.
E. H. Titchener & Co., Binghamton, N. Y.
Titeflex Metal Hose Co., Newark, N. J.
Todd Cumbustion Equipment, Inc., New York
Towmotor Co., Cleveland
Transue & Williams Forging Corp., Alliance, Ohio
Trojan Powder Co., Seiple, Lehigh County, Pa.
Tube Turns, Inc., Louisville, Ky.
Tyer Rubber Co., Andover, Mass.

U

Union Asbestos & Rubber Co., Paterson, N. J.
Union Steel Castings, Div. of Blaw-Knox Co., Pittsburgh
United Aircraft Corp., Hamilton

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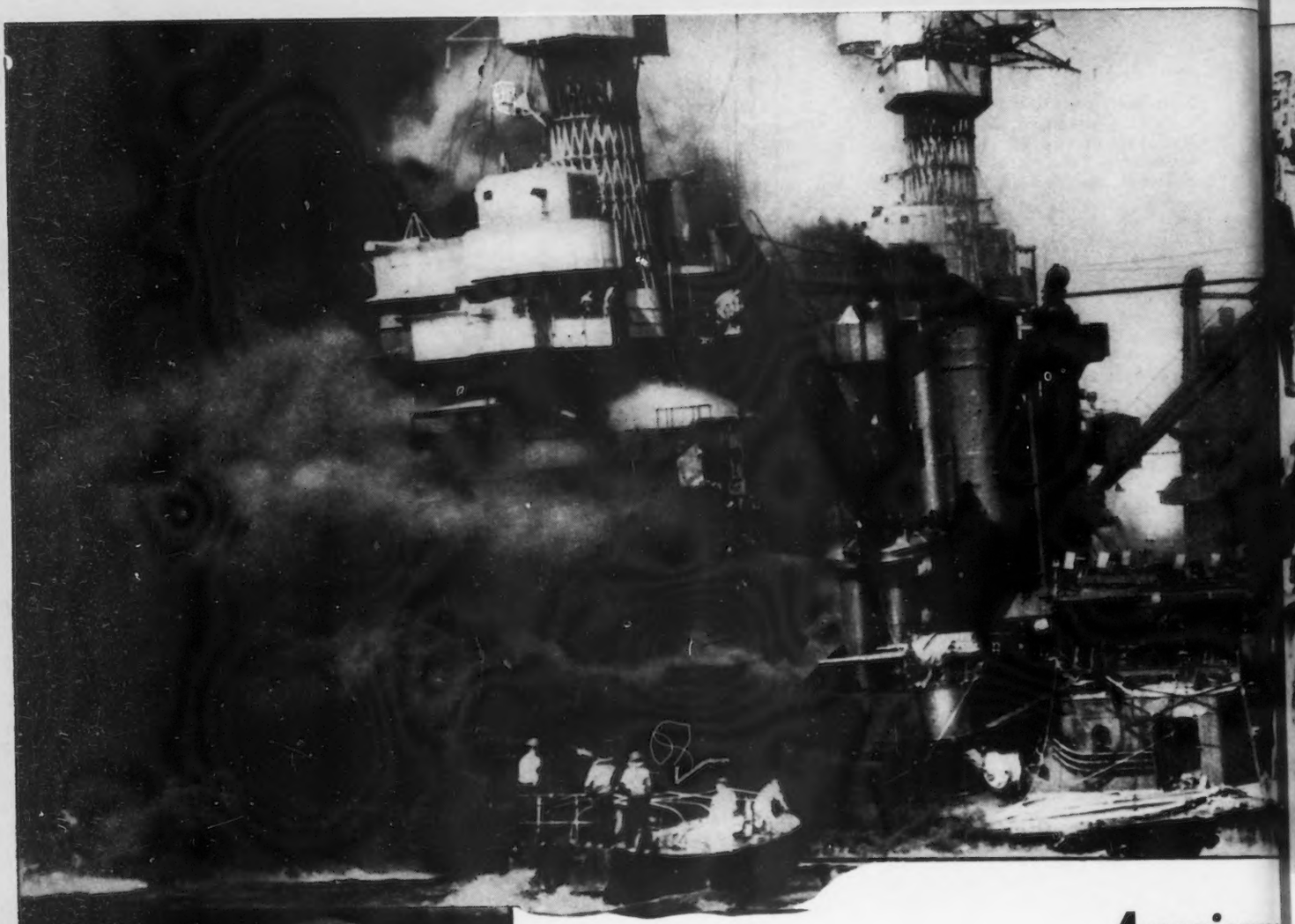


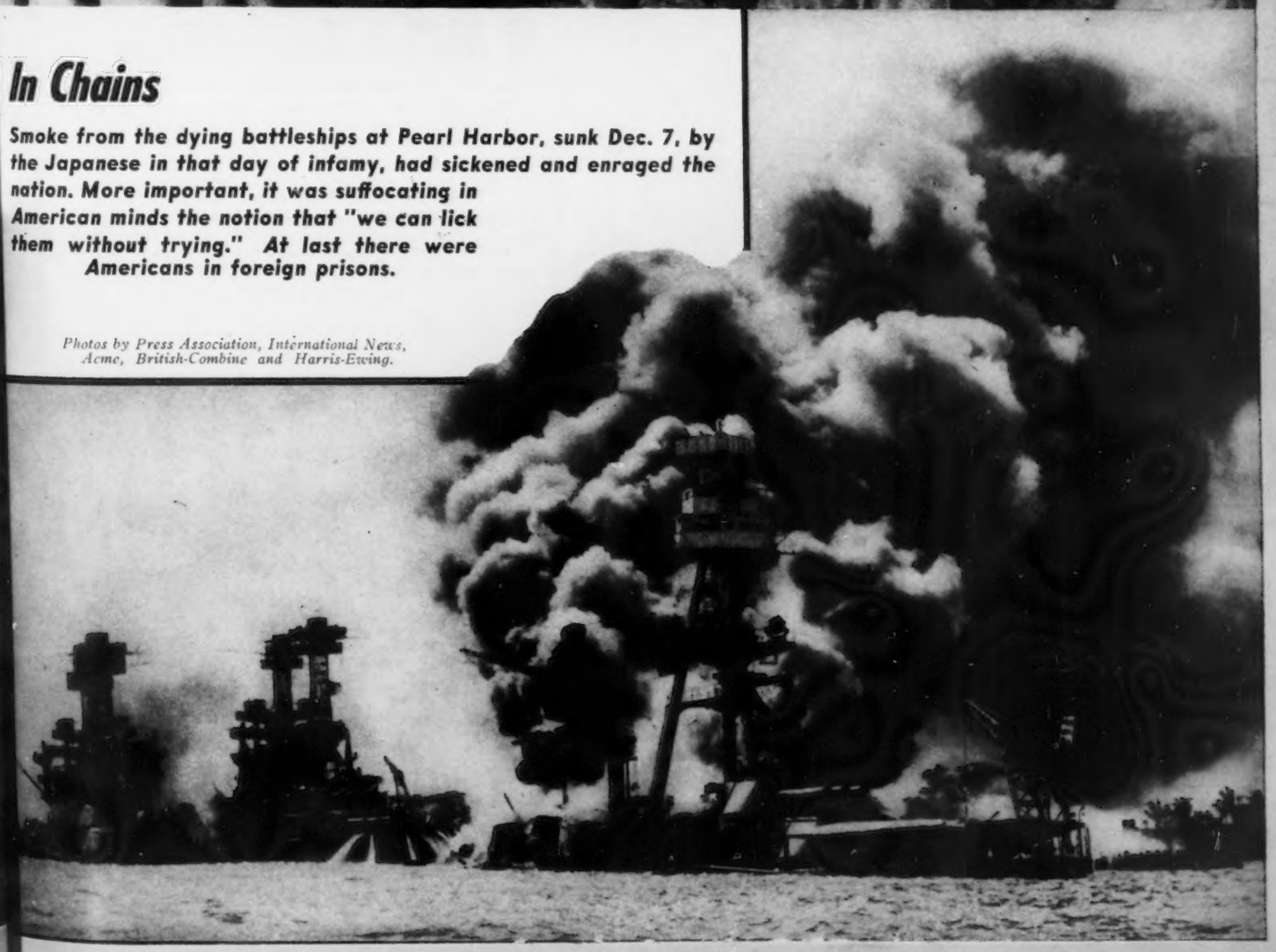
Americans

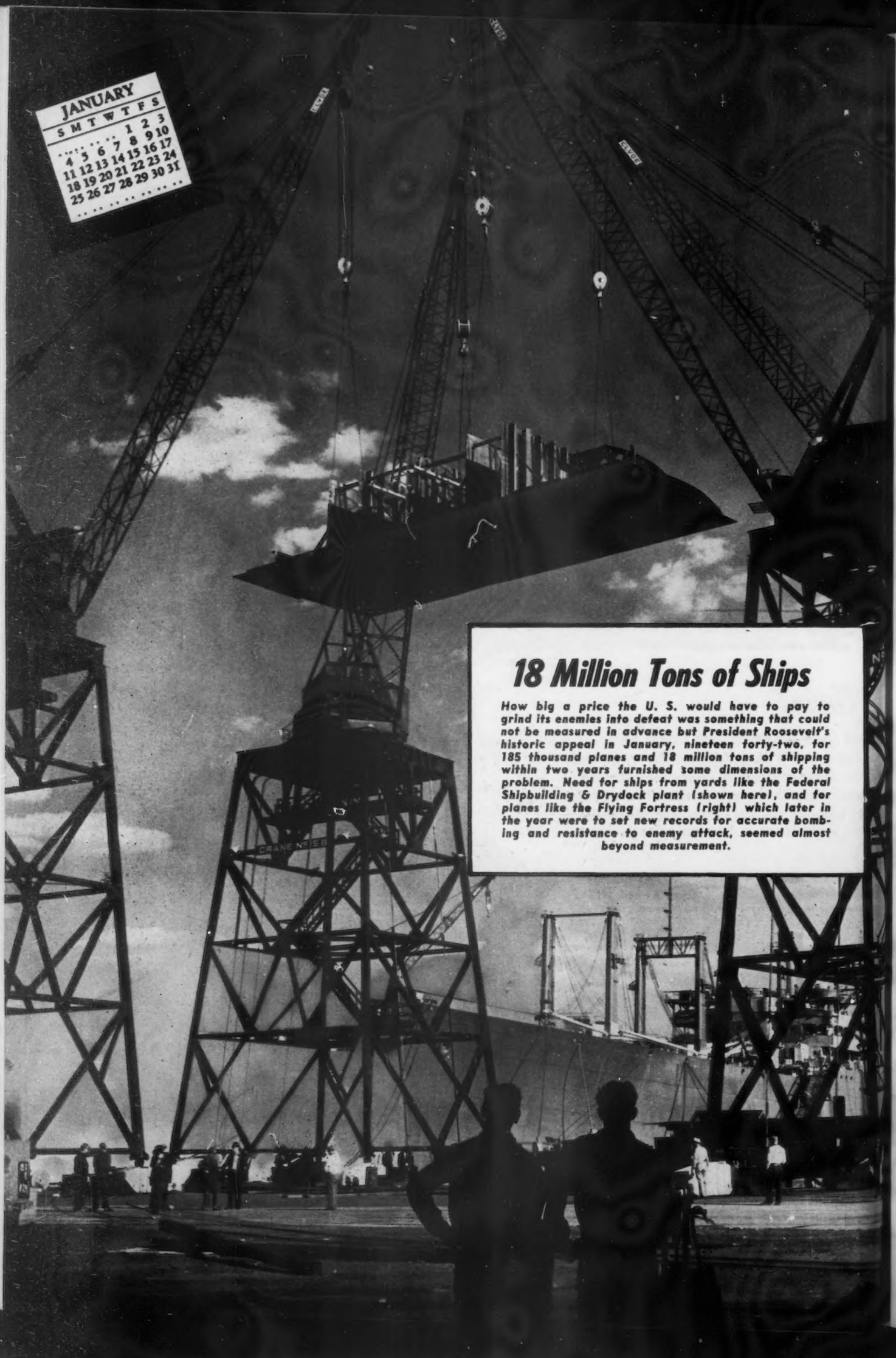
January the first, nineteen forty-two, was bright and clear but the brightness was only in U. S. skies. In most U. S. hearts, it was dark. Christmas and New Year's were uneasy holidays, observed defiantly by those few who knew, and half-heartedly by millions who felt, without knowing, that the U. S. was then in mortal danger.

In Chains

Smoke from the dying battleships at Pearl Harbor, sunk Dec. 7, by the Japanese in that day of infamy, had sickened and enraged the nation. More important, it was suffocating in American minds the notion that "we can lick them without trying." At last there were Americans in foreign prisons.

Photos by Press Association, International News, Acme, British-Combine and Harris-Ewing.



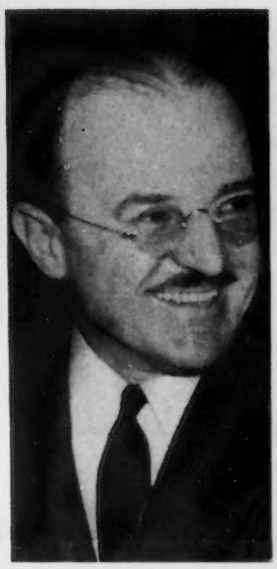


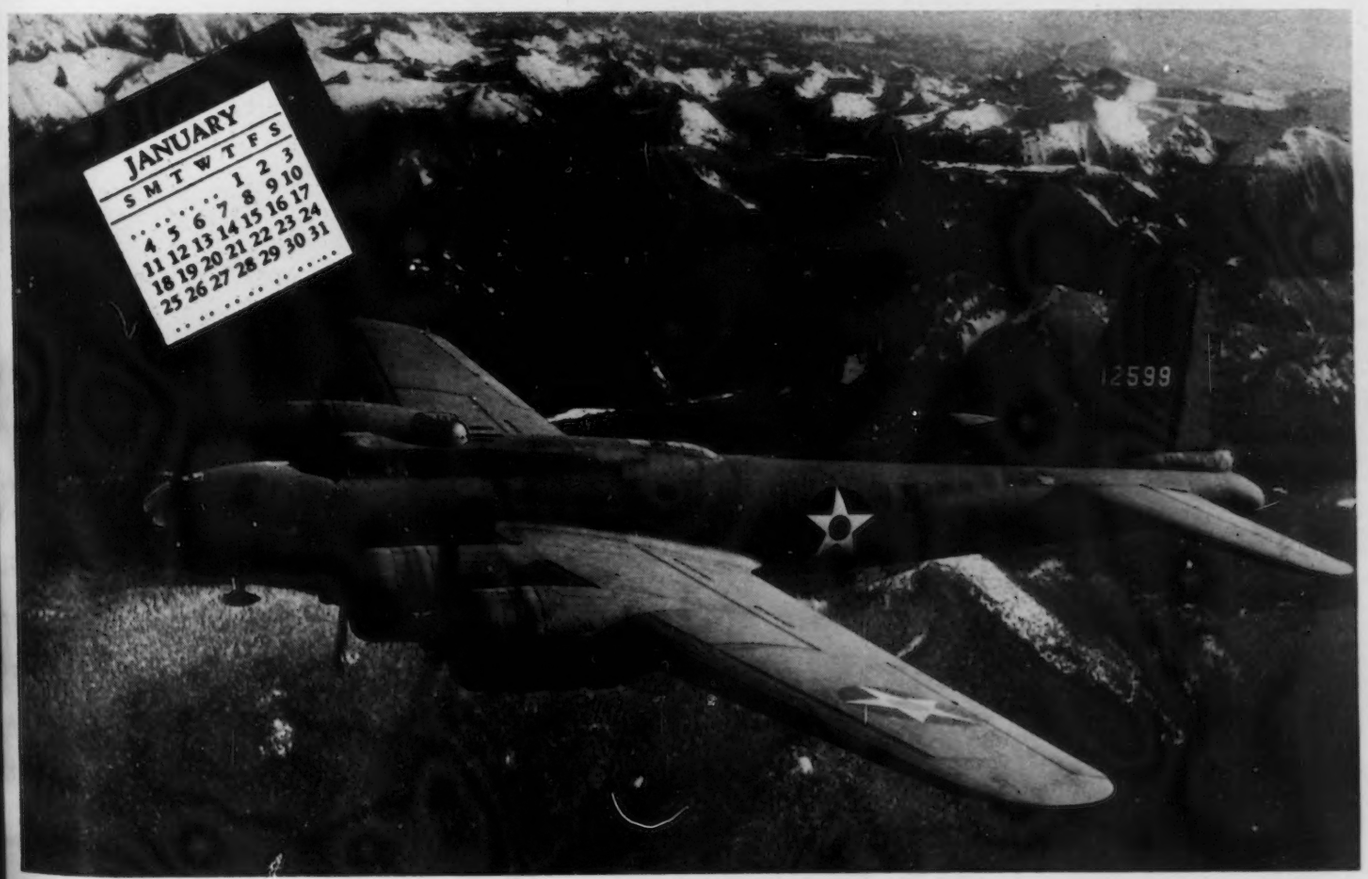
18 Million Tons of Ships

How big a price the U. S. would have to pay to grind its enemies into defeat was something that could not be measured in advance but President Roosevelt's historic appeal in January, nineteen forty-two, for 185 thousand planes and 18 million tons of shipping within two years furnished some dimensions of the problem. Need for ships from yards like the Federal Shipbuilding & Drydock plant (shown here), and for planes like the Flying Fortress (right) which later in the year were to set new records for accurate bombing and resistance to enemy attack, seemed almost beyond measurement.

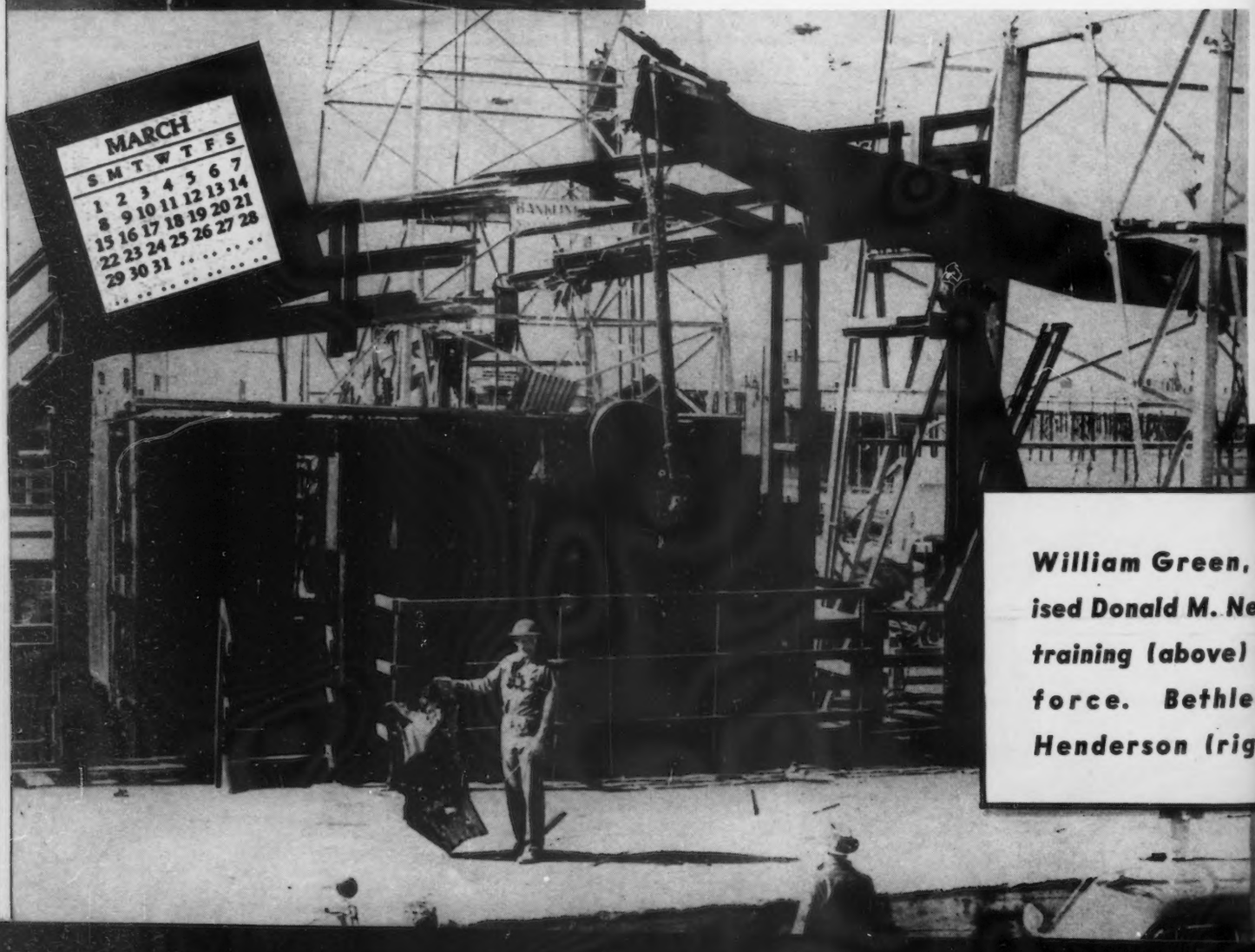
And 185,000 War Planes

Donald M. Nelson, the War Production Board chief (second from left, below) declared that "This is our critical year" while some critics were wondering "how tough is Nelson?" Ernest M. Kanzler, newly-appointed head of the WPB (first from left, below), warned industry: "We must use our imagination." George M. Brainard (third from left), went to Washington to direct WPB's machine tool branch. The new War Labor Board chairman, William H. Davis (head in hand), said in January: "I am against any form of compulsion in labor mediation."

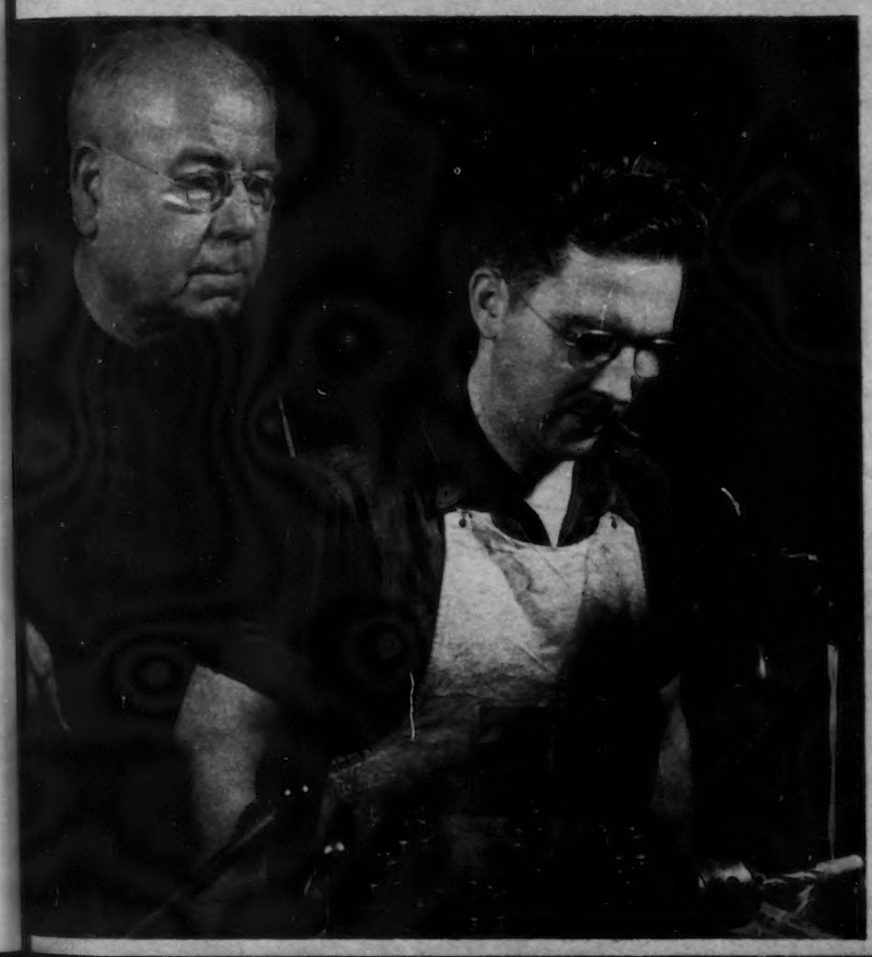




In February another U. S. ship was to die at anchor, placing still more pressure on U. S. shipyards and steel mills rolling ship plates, and reviving the cry: "Where is the Navy?" On Feb. 9, the great troopship "Lafayette," née "Normandie," ignited by a welder's torch, groaned and turned over (left) in the Hudson River with a bellyful of water. Cause: carelessness! While the nation was toughening up, converting its civilian product plants to war use, deciding that the right to strike might become a wartime luxury, the month of March brought another shock. A long, gray Japanese submarine surfaced in the Pacific off Elwood, Cal., 110 miles north of Los Angeles and fired 25 shells, hitting the plant below, bombarding the American mainland for the first time in this war.

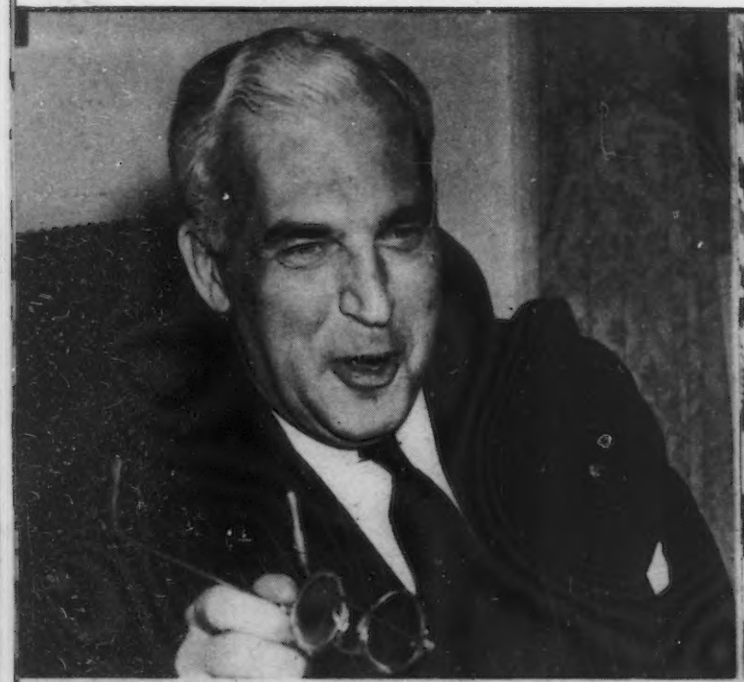


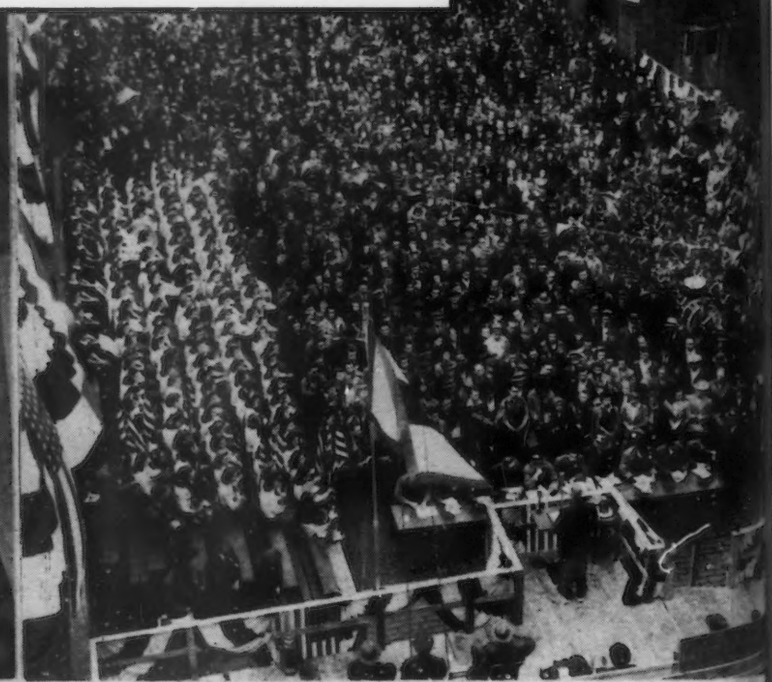
William Green, AF
ised Donald M. Nelso
training (above) wa
force. Bethlehe
Henderson (right)

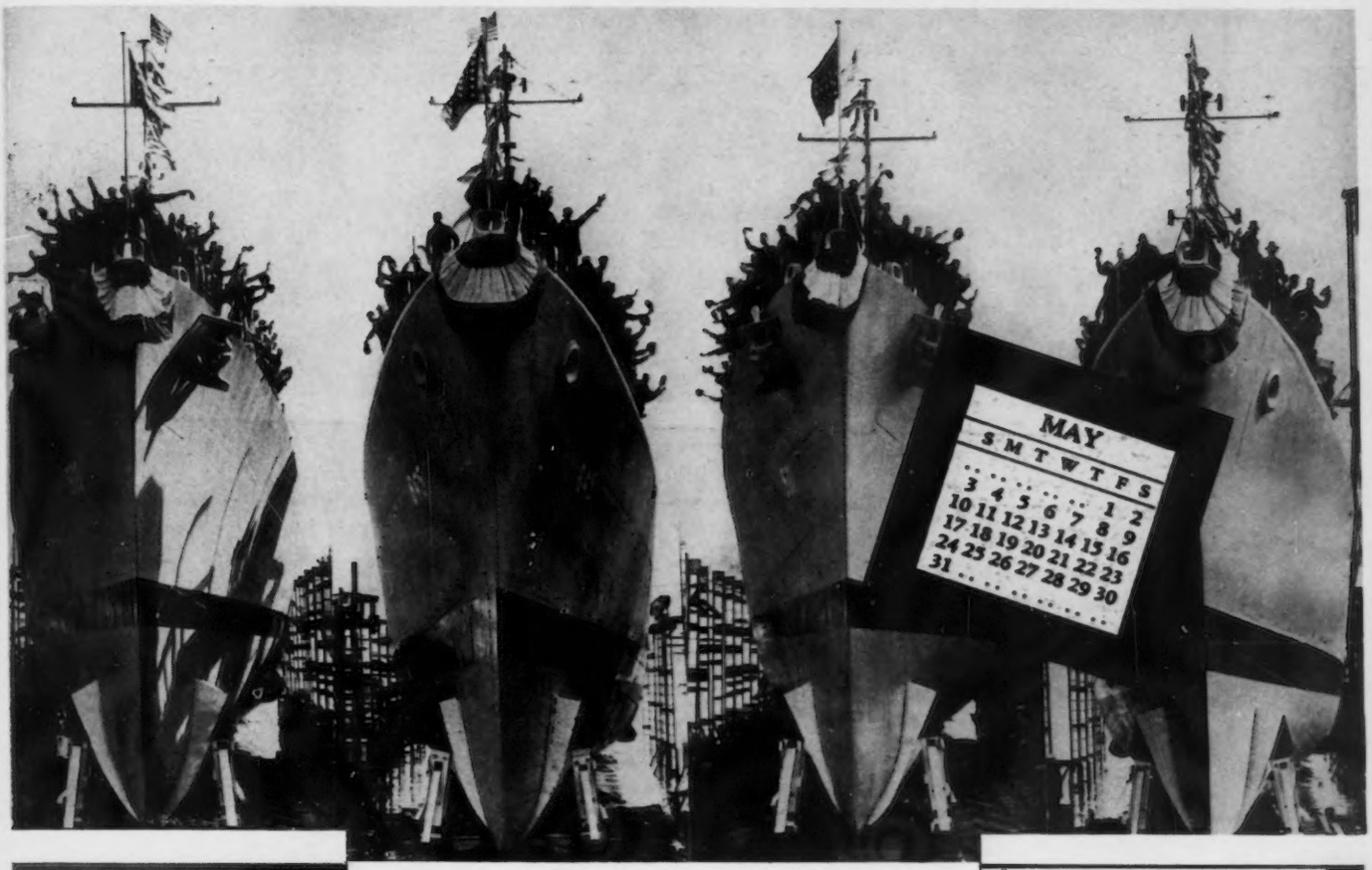


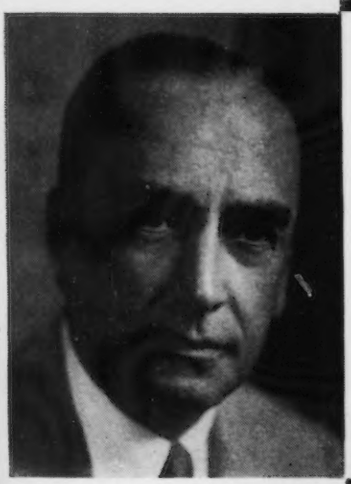
president (top left), and Philip Murray, CIO president, prom- (top center), to help the war effort. Speedup of employee forced by growing inroads of the draft in the skilled labor Steel Co. produced another big gun (top right), and Leon Price Administrator, warned of dark days of rationing ahead.

By April one, nineteen forty-two, shortage of alloy steels necessary to beat the Axis had become severe but alloy furnaces, like the Carnegie-Illinois Steel Corp. unit above, were rapidly being built to help solve this problem. U. S. electric furnace capacity had reached 3,737,510 tons yearly. Paul V. McNutt (lower left), chairman of the War Manpower Commission, on April 20, announced he would create a system of labor priorities. At a New York war plant, Lieut.-Gen. Brehon B. Somervell, U. S. Army Service of Supply, told war workers that the lives of American soldiers might hang on minutes wasted in this race of production. He said: "Remember the Men of Bataan."









But May showed that the tide of American war output was steadily rising. A U. S. Steel Corp. subsidiary launched four destroyers on one day (above). Reese H. Taylor (bottom photo) succeeded C. E. Adams (left) as chief of the WPB Iron and Steel branch and the famous Priority order, M-126, was issued, listing 360 items which could no longer be made of metal.

June 4, 1942

THE IRON AGE PRIORITIES GUIDE

... Prepared by the Priorities Staff of THE IRON AGE for use of industry and Government offices dealing with wartime controls of materials and machinery

WARNING

To do business under wartime conditions, industry in the United States and Canada must keep itself informed as to the LATEST developments in Priority Controls.

Please destroy earlier editions of THE IRON AGE Guide. Use only this SIXTH Edition.

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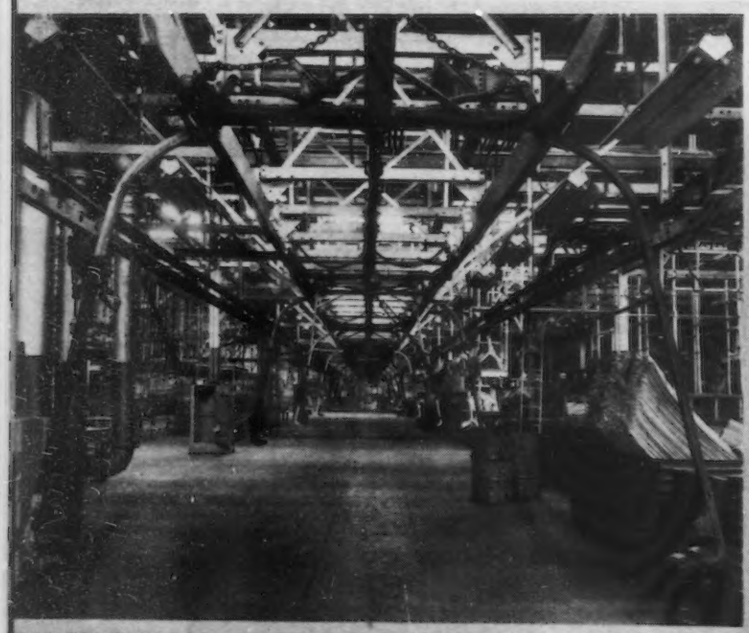
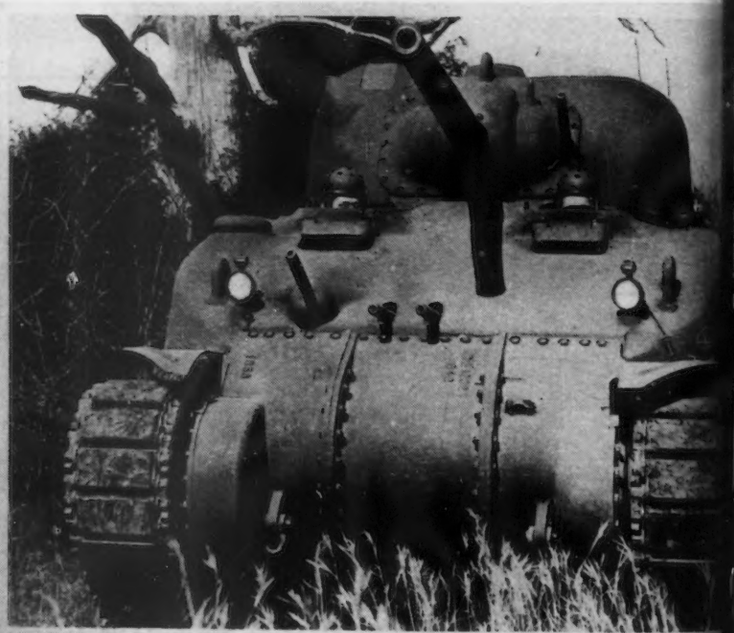
REMEMBER: Send week sections for keeping this Priorities and Allocation Guide up to date appear in THE IRON AGE. They are printed on the Priorities and Price Page. See THE IRON AGE for details and interpretations of War Production Board orders affecting the metal industries.

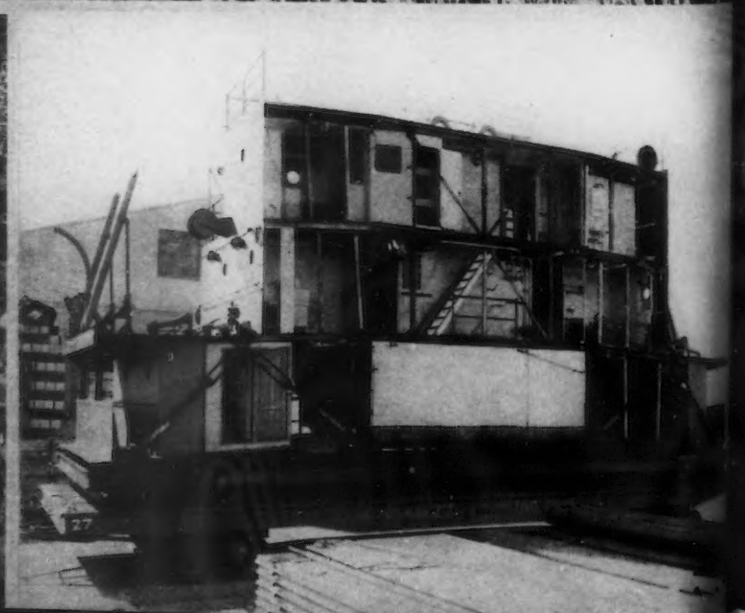
THE IRON AGE, 100 E. 42nd St., New York, N. Y.

SIXTH EDITION

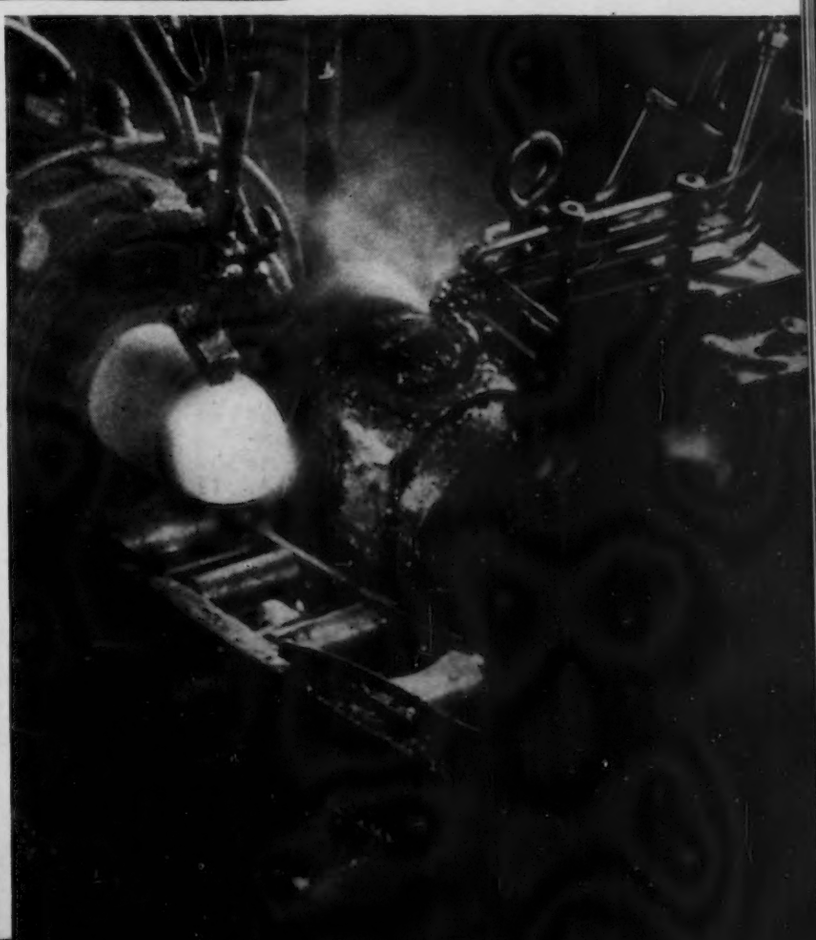
Helping to make America great was the automobile. Yet America had to give up automobile production to remain alive. Plants like General Motors, Ford, Chrysler (left below) and others became silent for a time and then swiftly turned into production of war implements like the latest M-4 medium tank (middle right). On both coasts and inland ship-builders were striving, by mid-June, to reach the president's 8 million ton goal for 1942. Some were pre-fabricating ship sections such as that pictured at the bottom of the page. To help war production, the new Chief of Ordnance, Lieut.-Gen. Campbell appointed (civilians above, left to right) Benjamin F. Fairless, Jr., U. S. Steel Corp. chairman; E. T. Keller, president, Chrysler, and Lewis H. Brown, president, Johns-Manville.

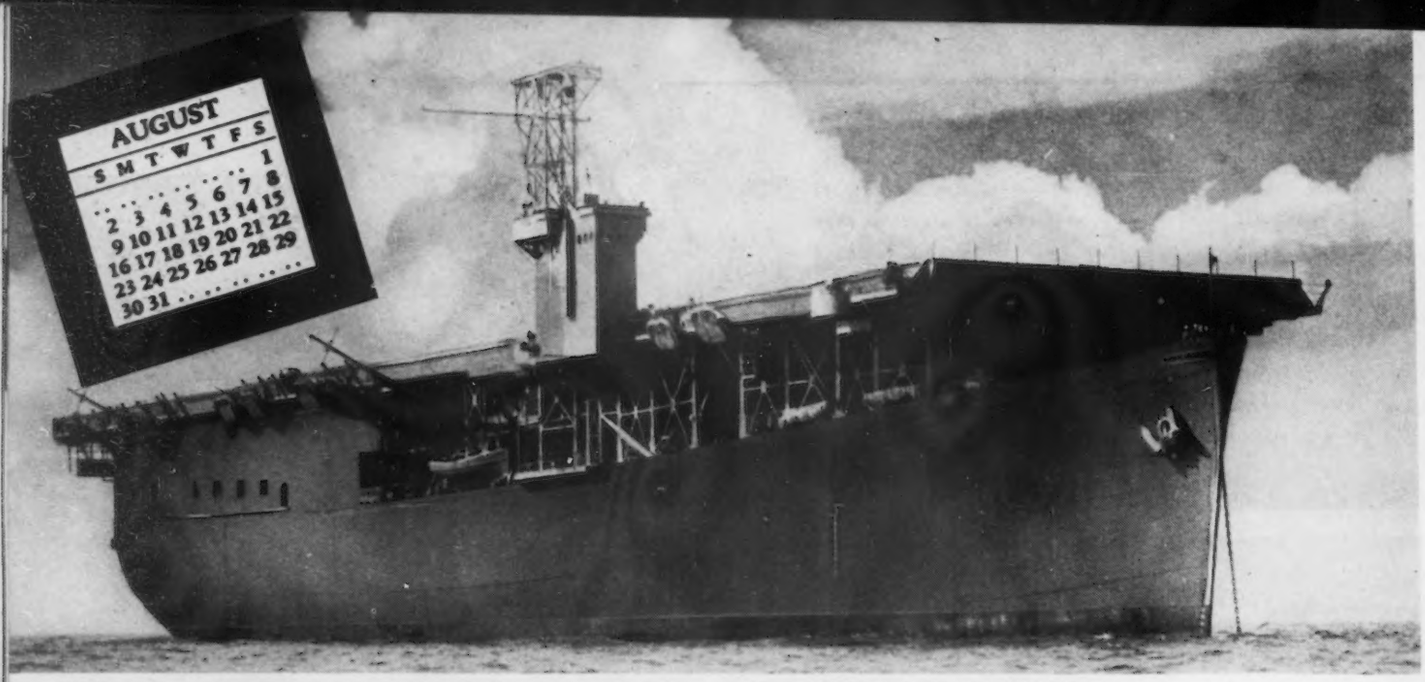




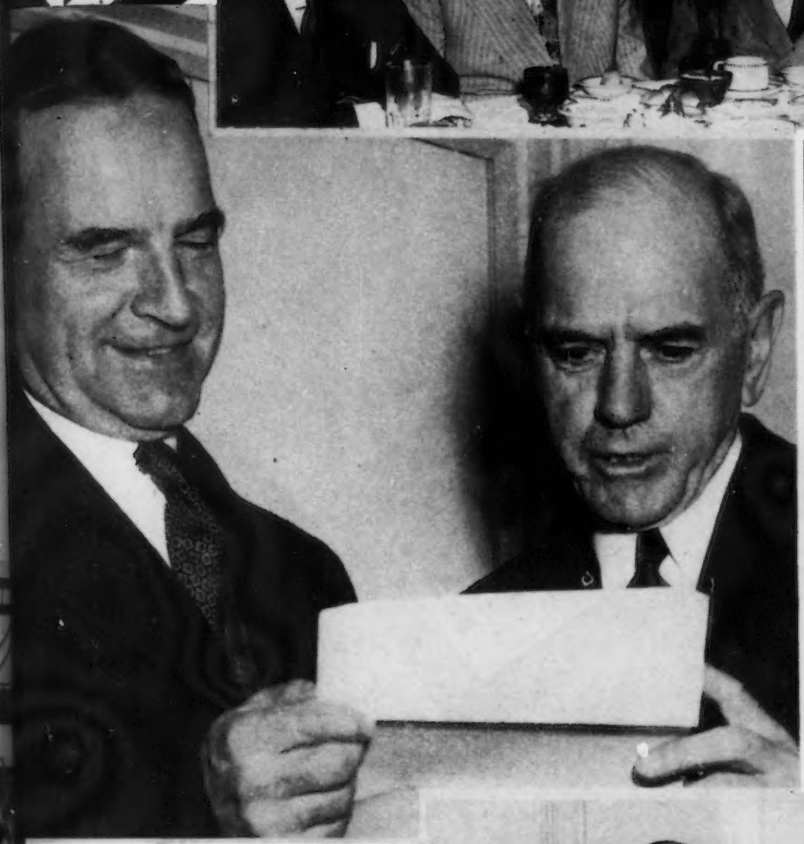


In July, Philip Reed (right), WPB Industries Branch Chief, told the House Small Business Committee that 24,000 small plants would be forced to close up shop before Oct. 1 because they would be unable to share in war production and obtain needed materials. West Coast airplane builders (below) organized to pool production ideas, women began training for many war jobs hitherto held only by men (below). At the lower right a workman is "spinning" the business end of a bomb casing, another job which some day may be done by women.





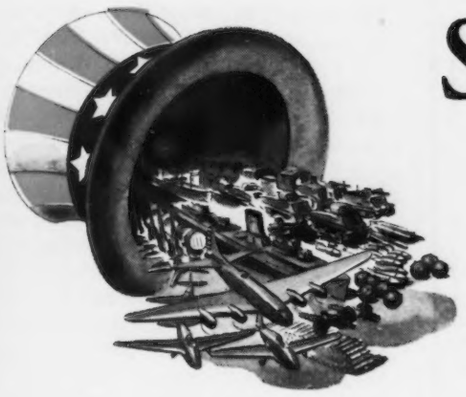
By August submarine sinkings in the Atlantic had forced the large-scale conversion of merchant ships to aircraft carriers (top). The 45,000-ton "Iowa" (right), then the largest battleship ever built, was launched adding fuel to the controversy over whether the battleship had been made obsolete through airpower. The "Iowa," with its sister ship, the "New Jersey," to be launched several months later, was expected by critics of the usefulness of such ships to be among the last such vessels built. A corn field had been turned into a Fisher Body tank plant (above). Andrew J. Higgins (right) charged a black market existed in steel.



By the end of summer, 1942, Henry J. Kaiser, West Coast builder of dams, ships, steel plants and, possibly, cargo-carrying airplanes, had made his mark among wartime industrialists. Full of advice on many things, Kaiser (second from right at top) talked to many men, including, in the same photo, from left to right, Grover Loening, WPB consultant; and Plane Builders Glenn L. Martin, Donald W. Douglas and John K. Northrop. Chairman Irving S. Olds (left), U. S. Steel Corp. chairman, announced his company was building a midwest tank plant. With Olds is Eugene G. Grace, Bethlehem Steel president. J. M. Hopwood (right), president of newly-formed War Materials, Inc., said "the war can be lost on the basis of scrap," although backed by industry, he suddenly resigned on finding he was being hamstrung by other government agencies.

First meeting of the Production Executive Committee, held in October, emphasized the need for unity on production for the Army, Navy, Industry and WPB. The Committee's members (at the left) are l. to r.: Rear Admiral Howard L. Vickery, vice chairman, U. S. Maritime Commission; Lieut. Gen. Somervell, commanding general, Army Services of Supply; Charles E. Wilson, WPB vice chairman; Vice Admiral Samuel M. Robinson and Maj. Gen. Oliver P. Echols. Ferdinand B. Eberstadt (bottom right) was appointed WPB vice chairman. The steel scrap shortage, which saw a national campaign of household scrap collection, reached a point in October where a few hysterical people such as those at Yonkers, N. Y. (photo below), were tearing off their bumpers for scrap.

George M. Verity (left), esteemed founder of American Rolling Mill Co., died in November. Hiland G. Batcheller (top, center), Allegheny-Ludlum Steel Corp. president, who had been for a time chief of the WPB Iron and Steel branch became chief of the WPB steel "division." Andrew J. Higgins (top right), New Orleans industrialist, urged the President to allow him to build huge cargo planes in his Louisiana shipyard. But November's big news was the invasion of North Africa by an American army, equipped with American tanks, planes and guns. In the first year after Pearl Harbor U. S. industry had produced 49,000 planes. 32,000 tanks and self-propelled artillery, 17,000 anti-aircraft guns larger than 20 mm., and 8.2 million tons of shipping. The U. S. had, in the year since Pearl Harbor, won supremacy over the Axis in war production. It knew it could win the war by trying.



STEEL . . .

--Training Period Gives Way to War Phase

o o o

By T. C. CAMPBELL
Pittsburgh District Editor, THE IRON AGE

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THE year 1942 was an excellent training period for the steel industry. It prepared the industry for the 1943 stark realism of a shooting war with its casualties, both to men and equipment. Last year was actually one of preparation and changeover from the commercial-war phase to the all-out war phase. Accomplishments were demanded in a year which, under ordinary conditions, might take four to 10 years to achieve. This year will see a consolidation, improvement, and "training down" of the lessons learned in 1942.

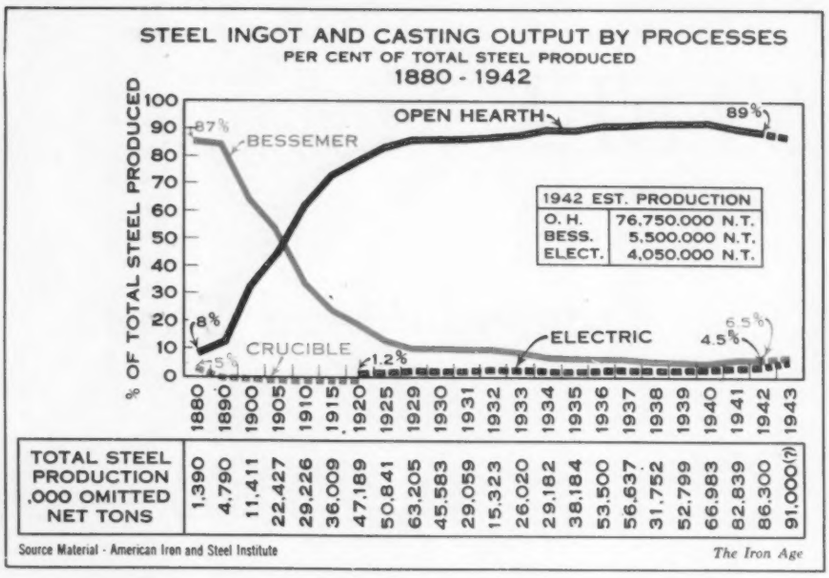
With no intent to be overly optimistic or indulge in chest thumping, it can be said that the steel industry not only performed "the impossible" in many programs during 1942, but also quietly put many of its critics up as candidates for the Ananias Club. Among the technological changes and other outstanding achievements last year were the conversion of strip mills to plate making, the growth of low alloy armor plate steels, the increase in production and perfection of high quality steels, the unprecedented speed in repairing open hearth furnaces and blast furnaces, and the increased use of "intensifiers" which has resulted in further conservation of strategic raw material.

In addition to these general solutions, there have been, during the past year, some definite trends such as a proportionate increase in the use of bessemer blown metal both as bessemer ingots and as raw material for open hearth products, a startling growth in alloy steel production with an important increase in the percentage of this steel made by the electric furnace process, and the tremendous expansion in the use of hot topping facilities.

With full knowledge of what has been accomplished, the "wise money" in the steel industry is not being fooled into believing that 1943 will be a Sunday School picnic. There is still an extreme shortage of certain alloy steel which will become increasingly severe as the new war phase continues. There is a shortage of critical materials which, in many cases, has forced the cancellation or suspension of some programs, thus putting pressure on existing equipment to finish the needed job. Hot topping facilities at the turn of the year were far below the new and revised requirements. The problems of distribution, while showing a tremendous improvement in solutions, have yet far to go in order to fully exploit the American productive capacity. The changes in the battlefront, both as to location and nature of the war being fought, will require a flexibility on the part of the steel industry in 1943 which will make 1942 look like slow motion.

Plate Production Phenomenon

Previous to 1941 when total plate production was 6,200,000 tons, the other high point was in 1929 when 5,600,000 tons of plates were produced. These figures fade into insignificance when matched against the estimated production of 12,000,000 tons in 1942. Last year's figure is expected to be dwarfed in 1943 when as much as 15,000,000 tons of plates may be produced. This achievement was attained in 1942 by very little increase in plate



IN 1880 when slightly more than 1,000,000 tons of steel were produced, bessemer steel accounted for 87 per cent of this total and open hearth 8 per cent, the balance being crucible or miscellaneous. The growth of the Western railroads and hence the growth of commerce and business was made possible by the bessemer process which was heavily utilized in the making of rails. It was the scrap from the bessemer process of making steel which furnished the important part of the raw material that started the open hearth process on a tremendous growth—a growth so rapid that in 1942 steel made in the open hearths constituted approximately 89 per cent of the 86,300,000 tons made. Had the bessemer process not been the leader in the early turn of the century, the growth of open hearth steel production would have been exceedingly slow since it would have had to grow "on its own scrap." Even today the bessemer process may be down but it is by no means out since blown metal from the converters not only goes to bessemer ingots but is also utilized as bessemerized metal in the open hearth for duplex steel, synthetic scrap, and molten scrap.

rolling capacity. Practically all of the expansion was the result of converting high speed continuous sheet mills to plate production. Most of the equipment, changes and additions were at the finishing end of the mill where auxiliaries such as handling and shearing had to be added. Actual production on various high speed continuous mills, even when rolling plates, has been substantially higher than the theoretical capacity placed upon the mill when it was built.

One continuous mill which, it was estimated, could roll approximately 60,000 tons of steel a month (sheets), actually reached 104,000 tons in a single month. Most high speed mills in this category are now actually rolling more plate per month than the capacity set for sheets on these units. Thanks to the foresight of the steel industry in building these mills, the most important lifeline in the present war—ships—will probably be the determining factors in the winning of the war.

Coincident with and closely tied in with the plate production program, has been the manufacture of alloy steels for tank and other similar armor plate which has utilized the more abundant alloys and saved the more critical ones. There are at present steels being made at many plants which, through the use of intensifiers, manganese and molybdenum, have passed the most stringent ballistic test of the ordnance department. The turn of the year found the tonnage of such steel phenomenally expanded compared with the production of just a few months ago. The experimentation and precise control on the industry's high speed continuous mills has enabled mass production of the lighter armor plate where in former years such a feat would have been impossible. The criticism of several years ago involving the accusation that the country was overcapacitated in the flat rolled steel category is now a memory which many would like to forget.

Quality Steels More in Demand

The increasing exactness of requirements growing out of modern warfare has caused a tightening of specifications and diligence in application not heretofore matched in the steel industry. Not only are alloy steels subjected to the most complete scrutiny from start to finish in order to utilize every ton made and thus eliminate "the losing of heats," but to a lesser extent the same stringent requirements have affected the production of ordinary carbon steels. This has necessitated an expansion in research and practical application of hot topping technique. Under ordinary conditions and even now the hot topped ingot from the open hearth to the finishing mill is "high class stuff" and must be treated accordingly. Nevertheless the speed with which the steel industry has produced and processed special quality steels far outweighs the equipment with which they had to do this job. At the present time, however, a point has been reached where the increase in hot topping requirements must call for either a sacrifice on the part of less urgent steel needs or an almost impossible task of further building, changing and rearranging present steel facilities. Steel companies last month were closely checking the ultimate destination of some hot top steel to see whether this practice was absolutely necessary. If a let down in overall requirements for ordinary steel should materialize, more trackage, soaking pit space, and blooming mill capacity would be available for hot top steel.

Repairs Set New Records

No matter what is done, however, on the highly important question of producing enough hot top steel, the problem will remain for the duration. There will be improvement in handling and an increase in tonnages but this will only spur the demand for an expansion on both counts. Furthermore, the increase in the production of high grade steels will continue to a greater degree to effect overall steel production. Alloy and other special steels require longer time for melting, handling and processing. A drop in steel ingot production then during 1943 would not necessarily mean that the best was not being done, but rather, that those things which should come first are coming first.

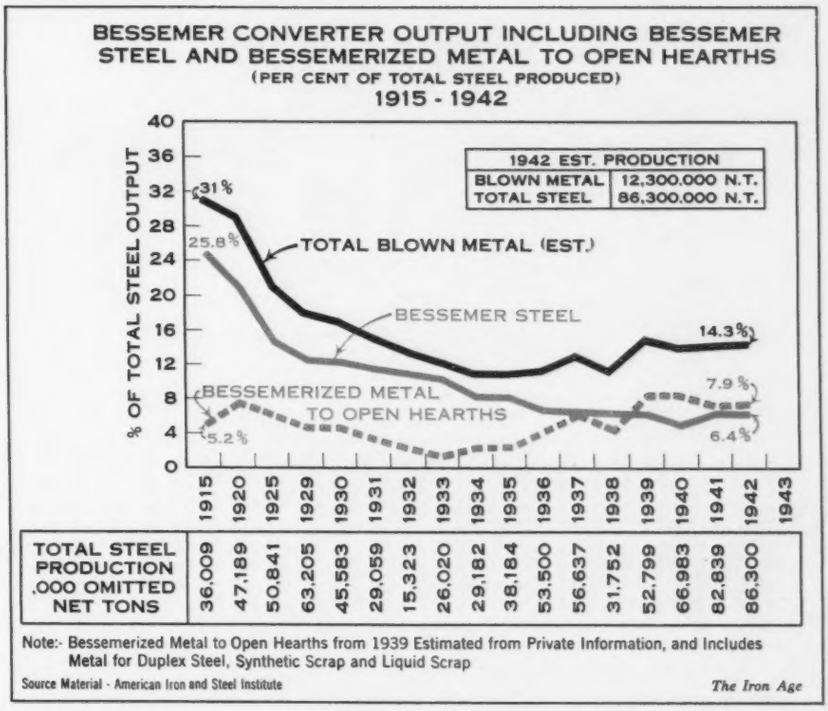
Outstanding in maintenance and repair achievements last year must come the fine work done in repairing and relining blast furnaces and open hearths. In 1929, cigars,

were passed, bonuses were granted and everybody shook hands with each other, when a blast furnace relining job was completed in about 60 days. Today if the job is not done in 21 days, two or three vice-presidents and a score of lesser lights walk around with frowns on their faces. An actual gasp went up in the blast furnace fraternity a few weeks ago when one steel company performed the following work on a blast furnace in 21 days: A relining job, a new hearth jacket, a new tuyere jacket, a new bustle pipe, mantle repairs and enlarging of the stack diameter. This job, it is said, has put the famous one-arm paperhanger to shame, but on the other hand has supplied the impetus for all other blast furnace operators to do likewise since this fraternity is highly competitive on production jobs.

Probably not as romantic but representing just as good a job have been the outstanding performances in relining and repairing open hearths. Another factor in the 1942 experience has been the discovery that in times of emergency the use of various short cuts and ingenious methods will enable the pushing of blast furnaces and open hearths far beyond what was once thought to be a maximum.

Alloys Reach New Heights

From a tonnage standpoint, alloy steel production has grown from approximately 2,000,000 tons in 1920 to 11,000,000 tons in 1942 and there are some who believe that approximately 15,000,000 or 16,000,000 tons of alloy steel will be made in 1943 with other conservative estimates running between 13,000,000 and 14,000,000 tons. While the open hearths have continued to make more alloy steel in the past few years than in peace times, the percentage of alloy made by the open hearth process to total alloy steel produced has been declining since 1938 (see accompanying chart). This condition has been brought about by a tremendous surge in electrical furnace capacity, as well as the more exacting requirements resulting from the war. With plenty of controversy throughout the industry as to what will happen to the tremendous electric steel capacity after the war, the following seems apparent, even at this time. Electric furnace operators will operate their plants and seek new and further fields of application. The competition between open hearth and electric alloy steel will make past experiences mere child's play, and finally, the tremendous change in human habits and desires after the war will no doubt prevent alloy steel production as a whole from resuming a more or less stabilized relative position which it took from 1931 to 1938.



Note:- Bessemerized Metal to Open Hearths from 1939 Estimated from Private Information, and Includes Metal for Duplex Steel, Synthetic Scrap and Liquid Scrap

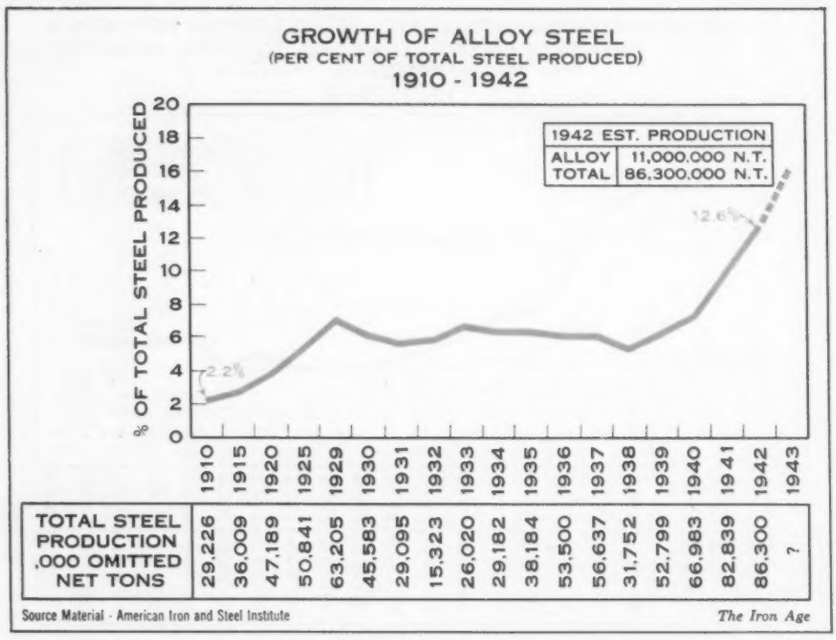
Source Material - American Iron and Steel Institute — *The Iron Age*

PUBLISHED data on bessemer steel ingot output does not tell the whole story about the part bessemer converters are playing in the production of total steel. An attempt has been made here to trace total blown metal from the converters from 1915 to 1942. It is indicated that in 1942 approximately the same amount of bessemerized metal was utilized as in 1931—in other words, total bessemer blown metal has maintained a fairly stable position with respect to total steel production since 1931, even though bessemer ingot output has shown more fluctuation. In 1937, in addition to bessemerized metal being used in duplex steel making, tonnages were also being used as synthetic scrap and as molten scrap.

Bessemer Down, Not Out

Not determinable from existing published statistics but nevertheless a fact, is the relative stable position of the output of bessemer converters with relation to total steel production in the past 10 years. Practically all public information on bessemer converter production is gleaned from statistics on the amount of bessemer steel ingots produced. A far greater tonnage of bessemer blown metal, however, has gone to open hearths as duplex metal, synthetic scrap or molten scrap than is generally believed. For the first time an attempt has been made to analyze this situation and although the figures and indications may not be exact, THE IRON AGE has obtained enough private data to establish a definite pattern (see accompanying chart). Popular opinion has led to the erroneous belief that the bessemer process is on its "last legs." A glance at statistics on bessemer steel ingots might give some general support to such an idea but when the actual output of the bessemer converters throughout the country is computed, it shows a fairly stable relationship between total steel output since at least 1931. Furthermore, in recent years a slight trend upward in the participation of bessemer blown metal has been noticed.

While 1942 estimates indicate a production of approximately five and a half million tons of bessemer steel ingots, probably slightly more than 12,000,000 tons of bessemer blown metal will have been made and consumed. The close to 7,000,000 tons of bessemerized metal which did not go into bessemer ingots has been utilized to make duplex steel, semi-duplex steel, synthetic scrap, and other cases where



WITH alloy steel tighter than a drum, interest is centered on this strategic product. Since 1910 when alloy steel constituted about 2 per cent of the total steel made, its growth has continued until 1942 when alloy represented approximately 12½ per cent of the total steel produced and it is estimated that by the end of 1943 this class of steel will be 16 per cent of total production. From a tonnage standpoint, alloy steel has gone from approximately 2,000,000 tons in 1920 to 11,000,000 tons in 1942.

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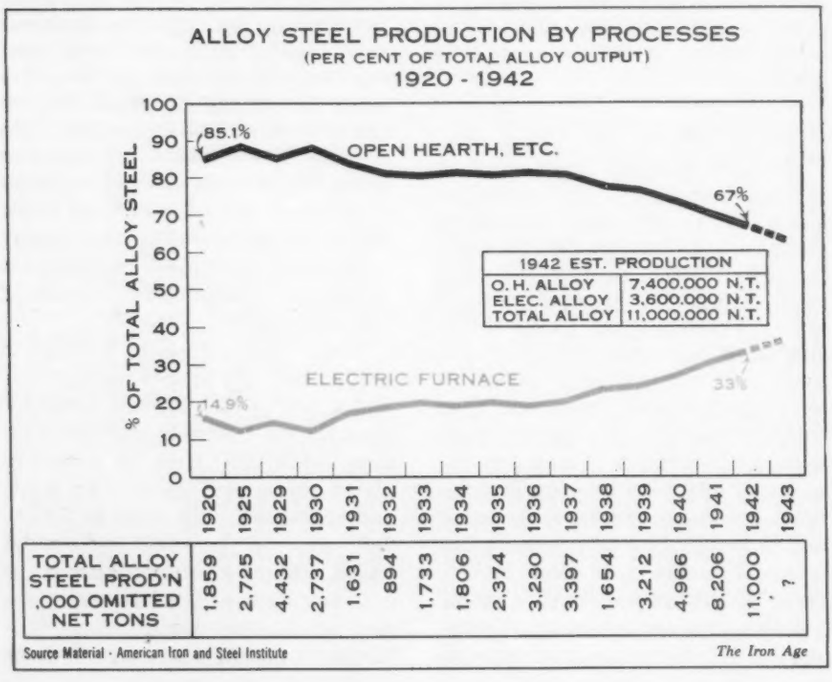
ALWAYS the nucleus for discussion among steel men is the percentage of electric alloy steel as compared with open hearth alloy steel. In 1920 approximately 15 per cent of the total alloy steel made came from electric furnaces and 85 per cent from the open hearth and some bessemer and miscellaneous furnaces. By 1942, due to a tremendous growth in electric steel capacity, 33 per cent of the total alloy steel produced came from the electric furnaces and 67 per cent from the open hearth. It is indicated that in 1943 the electric furnace participation in alloy steel will approximate 36 per cent of the total.


ALLOY STEEL PRODUCTION BY PROCESSES
(PER CENT OF TOTAL ALLOY OUTPUT)
1920 - 1942
% OF TOTAL ALLOY STEEL
85.1%
OPEN HEARTH, ETC.
67%
1942 EST. PRODUCTION
O.H. ALLOY 7,400,000 N.T.
ELEC. ALLOY 3,600,000 N.T.
TOTAL ALLOY 11,000,000 N.T.
ELECTRIC FURNACE
14.9%
33%
1920 1925 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938 1939 1940 1941 1942 1943
TOTAL ALLOY STEEL PROD'N ,000 OMITTED NET TONS
1,859 2,725 4,432 2,737 1,631 894 1,733 1,806 2,374 3,230 3,397 1,654 3,212 4,966 8,206 11,000 ?
Source Material · American Iron and Steel Institute
The Iron Age

a small amount of blown metal has been added to the open hearth charge. Whether or not this increased use of bessemer converted material will hold after the war remains to be seen. There are some astute observers, however, who believe that the answer to this question is tied up in answers to the following questions: In view of nation-wide scrap drives, will scrap be plentiful after the war? Will scrap prices decline to a point where it would be less profitable for some steel manufacturers to use molten bessemer metal or synthetic scrap? Will the increased use of bessemer steel ingots reach the point where bessemer ingots in themselves will enjoy a greater share of total steel applications? And finally, will the time come when the unfair curse on the word duplex has been removed by discussion and a soul searching analysis of the whole duplex steel question?

One thing seems to be certain and this has been brought out by 1942 experience. The existing bessemer capacity has been utilized continuously and to an extent far greater than generally supposed. The assumption that five and a half million tons of bessemer steel ingots represents the total bessemer picture is very misleading when more than 12,000,000 tons of bessemer blown metal has been utilized and when the bessemer converters throughout the country in the aggregate could probably blow if necessary between 14,000,000 and 15,000,000 tons of metal providing metallics were available. The blowing in of additional blast furnaces during the latter part of 1942 and those expected to be brought in this year enhance rather than detract from the bessemer potentialities.

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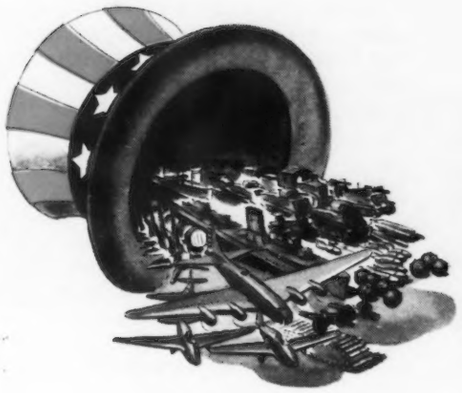
• • • The mailed fist of a land offensive is the medium tank. This first United States medium, the M-3, has slugged it out with the Pt-Kw IV, and the newer M-4 has walked over the best the Germans have so far put into the Libyan theatre.

UNIV OF MICH



Record Ore Movement-- 92,000,000 Tons

. . . The downlake movement of 92,076,781 gross tons of iron ore during the past nine months broke all records and was the industry's answer to the call for more raw materials to equip the greatest armed force in history.

"WELL DONE!" the coveted acclamation of praise used by the Navy in honor of superb performance could well be flown from the flag staff of every steel mill in the country in honor of the unprecedented, yet none the less Herculean, task accomplished during the past eight and a half months by the ore fleet in bringing some 92,076,781 gross tons of iron ore from the Lake Superior ore mines to the lower Great Lakes docks. This tremendous task, started on March 25 at the Marquette, Mich., ore range docks and on March 26 at the Duluth-Superior docks, coursed through the summer and autumn months without fanfare, and ended abruptly during the first week of December, after a 254-day season, when blizzards and sub-zero weather set in at the upper lake ports, making loading and shipping operations almost impossible.

In meeting the goal of 91,500,000 tons of iron ore shipped downlake during this year's shipping season, probably the greatest thanks that the fleet will get is a new and larger goal of 104,000,000 tons, set by Washington as next year's requirements. On the face of it, with the fleet operating at 100 per cent of capacity throughout 1942, it would seem that such a goal is impossible, but there are factors that enter into the picture that not only make it possible to meet this unprecedented standard, but also to beat this goal with comparative ease.

First of all, the fleet for next year will be considerably larger than the 305-ship fleet that wound up operations this year. Five new 18,000-ton ships were brought into service during the season just ended by the Pittsburgh Steamship Co. and another that has been out of the trade practically the whole season because it was wrecked in upper Lake Michigan late in June is back in service. In addition, through the Maritime Commission shipbuilding program, 16 new large ships will be in operation before the end of the next shipping season. While all of the new Pittsburgh Steamship Co. boats went into service this year, none of them saw a full season of operation, and the E. J. Buffington, whose salvage and repair job was the biggest ever performed on the Great Lakes, came back into service during the second week of November. With five of the Maritime Commission boats already afloat and three more scheduled to be launched and fitted before the season starts, eight of these new ships will begin with the first convoy north and eight more will be in service before Aug. 1, if construction schedules move along as now planned.

While these new boats, including those of the Pittsburgh Steamship Co., have a capacity ranging from 16,000 to 18,000 gross tons, full use of this huge carrying ability cannot be made. At the locks at Sault Ste. Marie, at the present time, ships that would require such a deep draft as the 24 ft. draft on these boats cannot be accommodated, but before the end of the next ore season it is expected that the General MacArthur locks will be completed so that even these big boats, loaded to their maximum capacity, can be handled with ease. However, loaded light, that is to somewhere between 14,000 and 15,000 tons, these boats can be handled in the existing locks.

New Boats Large

So, with even a minimum of five of the new Maritime Commision boats operating the full season of about 39 weeks, making an average of at least one 15,000-ton trip per week, some 2,425,000 tons can be brought downlake. With 11 more in operation by Aug. 1, oper-

TABLE I

Iron Ore Reserves of the Lake Superior District as of Jan. 1, 1942*

Range	State	Open Pit Direct Ore, Gross Tons	Underground Direct Ore, Gross Tons	Concentrate	Total
Mesabi	Minnesota	557,312,000	376,624,000	143,464,000	1,077,400,000
Vermilion	Minnesota	27,000	12,739,000	75,000	12,841,000
Cuyuna	Minnesota	10,048,000	37,689,000	16,677,000	64,414,000
Gogebic	Michigan	630,000	27,682,000	0	28,312,000
Marquette	Michigan	0	48,283,000	0	48,283,000
Menominee	Michigan	630,000	55,031,000	0	55,661,000
	Wisconsin	0	5,000,000	0	5,000,000
	Total Lake Superior District	568,647,000	563,048,000	160,216,000	1,291,911,000

* E. W. Davis report to the War Production Board.

ating at least 18 weeks, carrying the same amount of ore, some 2,980,000 tons will be brought down. Together, the least that can be expected from the new boats will be close to 5,000,000 tons, one-third of the difference between this year's 90,000,000-ton quota, which was surpassed, and next year's 104,000,000-ton goal. Consequently, with a fair break so far as the weather is concerned, giving the shipping season some 39 weeks, the 104,000,000-ton goal is not in the least impossible.

In considering also the feats in shipping accomplished by the ore fleet this year, it must not be forgotten that these boats also carried huge quantities of coal on return trips. As of Nov. 1, the Great Lakes ore fleet carried some 57,000,000 net tons of coal. Also, with one of the biggest grain crops in history standing in storage at Duluth, Chicago, and other elevators, the ore fleet will play a big part in transporting these vitally needed food supplies to the east where they can be prepared for domestic consumption and shipment abroad to our Allies.

Dock Space Limited

Confronting the movement of iron ore during the 1943 shipping season is one major obstacle. This obstacle is ore storing facilities. At the close of the current season storage space at the docks was loaded to capacity and that at the blast furnaces was utilized to its fullest extent. All told, at the docks there were some 44,000,000 tons of iron ore in storage. Even at the high rate of production at which the steel industry is now operating, there are only some 7,000,000 tons of ore used per month. A quick calculation of 91,000,000 tons divided by 8.5 months which the shipping season was open will show that an average of almost 11,000,000 tons of ore per month were moved down in 1942, and with the extended shipping capacity scheduled to go into operation next year, shipments could easily average 12,000,000 tons per month. At the consumption rate of 7,000,000 tons per month, during the 3½ winter months, the steel industry will use up some 25,000,000 tons from the stockpiles.

Another easy calculation will quickly show that an excess above consumption of some 5,000,000 tons of ore will be stocked monthly next year. By the end of August, ore inventories will again be so high that stocking space will not be available and there will still be some 3½ months of shipping. This condition at present is the only serious hazard to the attainment of the 104,000,000-ton goal set for the movement downlake of ore next year, and to date nothing definite has been done about it. To take care of the five new large ships, Pittsburgh Steamship Co. is enlarging some lower lake dock facilities, and there may be involved in the project an expansion of storage facilities. However, this has not yet been announced and is only a speculation.

TABLE II

Total Ore and Concentrate of the Mesabi Range*

Class of Ore	Type of Ore	Mining Method	Ore Reserves, Gross Tons
I	Direct Shipping	Open Pit	557,000,000
II	Direct Shipping	Underground	377,000,000
II	Gravity Concentrate	Open Pit	92,000,000
III	Magnetic Concentrate	Open Pit	5,000,000,000 to 10,000,000,000
II and III	Possible Concentrate	Open Pit	30,000,000,000 to 40,000,000,000

* E. W. Davis report to the War Production Board.

All Winter Shipments

There has been considerable discussion on keeping iron ore moving southward from the upper lake regions all winter this year, and at least two methods have been proposed. Shipping by rail throughout the cold months has been advanced as one method. Icebreakers to break through the frozen waters of the upper lakes, leading boats southward also have been proposed, but there have been several objections to this method. Contrary to popular assumption, the condition of the lake during the winter is not the final factor in determining the stopping of ore shipments. While the lake, in colder weather, presents navigating problems, the big problem is the ore itself.

The ore freezes in cars when carried from the mines and must be steamed to be removed from the cars. It freezes again in the ore pockets at the docks and again must be steamed before it can be loaded into the boats. These steaming operations greatly reduce the amount of ore that can be handled, making it necessary to lay up a number of boats, and slows down the operation of others. Thawing equipment was added during the past year to that already on hand and has been of great value already. While it will prolong the shipping season somewhat, it is incapable of handling the vast quantities of ore necessary to keep the fleet in operation all winter. The larger quantities of ore that will be required in 1943 have, however, made it advisable to build icebreakers for use in the St. Mary's river, between Lake Superior and Lake Huron, and these will make possible a very early opening of navigation next year.

Ore-wise, for the coming year, much has been said about the

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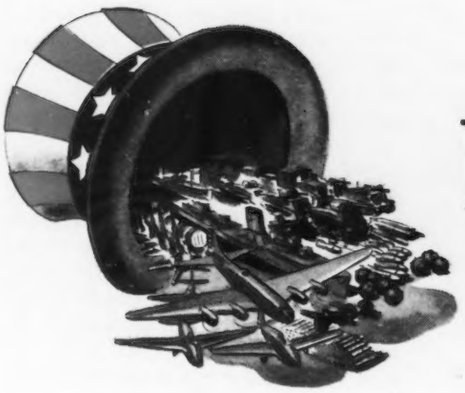

PIG IRON . . .

Output, quickly digested by scrap-hungry furnaces, vaulted capacity during record-breaking 1942.

° ° °

By S. H. BARMASEL
Associate Editor, THE IRON AGE

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IT was a warm, lulling concept pervading American thought in 1941 that we could remain the arsenal of democracy for as long as we wished, and when good and ready we would select the time and place we wanted to face the enemy. This opium-filled atmosphere evoked images of plenty of big guns and rich butter. Superimposed upon our civilian peacetime production, we could, and would, build our wartime economy.

Into this befogged America of September, 1941, W. A. Hauck, influenced by the politicians' insistence on a huge expansion of steelmaking facilities, delivered his first report. If 1942 was to be a year of delaying action, then blast furnaces could be built first, guns later. This country had enough time, manpower and materials to augment pig iron capacity by 13,810,550 tons.

But bombs dropping on Pearl Harbor that Sunday afternoon startled us out of our cozy cocoon. Wars are not fought and won without the most realistic and careful planning. No more could time be considered on our side. The choice was guns or else.

So realizing that no longer could much needed steel be diverted from war end materials, the second Hauck report of June, 1942, recommended that 21 per cent, or 2,865,550 tons, of the original expansion program be curtailed.

Among the blast furnaces to be deferred were those to be erected at the Alan Wood Steel Co., Conshocken, Pa., Bethlehem's Sparrows Point, Md., division and at the Colorado Fuel & Iron Co.'s plant at Pueblo, Colo. Also stopped were plans for building a furnace at Rusk, Tex., and two at Cleveland, one for Otis Steel and the other for Republic. The entire project of the Ford Motor Co., Dearborn, Mich., was dropped.

Of the 10,945,000 tons of increased capacity recommended for completion, 6,349,000 tons were to be finished by the end of 1942. Two furnaces had already been in operation at the time the government study was published. Tennessee Coal, Iron & Railroad Co. blew in one pig iron producer on April 11, thus adding 440,000 tons a year to the Birmingham district. At Gadsden, Ala., the first blast furnace financed by the Defense Plant Corp. as a part of the nation's expansion program was blown in on May 28. Operated for the government by the Republic Steel Corp., this air-conditioned furnace accounts for 280,000 tons of added yearly capacity.

By the beginning of December, three of the remaining six furnaces scheduled to start producing in 1942 were in operation. Blown in on Aug. 24 was the 1000 ton-a-day unit built for the American Rolling Mill Co. at Ashland. Republic Steel at Youngstown put into operation on Oct. 12 a new blast furnace capable of handling 1100 tons of pig iron a day, and on Nov. 16 at Indiana Harbor, Inland Steel Co. lighted its new No. 6 furnace, with a daily capacity of 1200 tons.

Still to be heard of are the two Bethlehem furnaces at Bethlehem and Lackawanna, N. Y., and the grass-roots unit at Fontana, Cal., to be operated by the Kaiser Steel Co.

Another phase of the expansion plan was the restoration of abandoned furnaces which was estimated to supply 1,235,000 additional tons. This program was expected to reach completion by the end of the year. At Granite City, Ill., one of these resurrected structures was already smelting iron ore the end of last year. Going into production during 1942 were the Cumberland Iron Co. at Cumberland, Tenn., and the Pittsburgh Ferromanganese Co., a subsidiary of Pittsburgh Coke & Iron, at Chester, Pa.

Moving day for the two small abandoned Joliet furnaces came the latter part of March. One of the pair was re-erected by the Columbia Steel Co. at Geneva, Utah, and the other at Duluth, for the American

Pig Iron Production, Including Ferroalloys—1942

	Annual Blast Furnace Capacity*	Pig Iron (net tons)	Ferro & Spiegel (net tons)	Total	Per Cent of Capacity
Distribution by Districts:					
Eastern	11,875,475	11,246,674	226,609	11,473,283	96.6
Pittsburgh-Youngstown	24,334,220	24,280,325	252,003	24,532,328	100.8
Cleveland-Detroit	6,038,945	6,210,530	.....	6,210,530	102.8
Chicago	12,935,790	12,655,048	75,145	12,730,193	98.4
Southern	4,391,450	4,120,955	118,515	4,239,470	96.5
Western	896,685	841,708	4,197	845,905	94.3
Total	60,472,565	59,355,240	676,469	60,031,709	99.3

Data from the American Iron and Steel Institute.

*** Average capacity available during 1942 computed by The Iron Age. Annual capacities as of July 1, 1942, according to the American Iron and Steel Institute, are, reading down, 11,967,680; 24,346,420; 6,068,470; 12,954,800; 4,521,910; 822,800; Total, 60,682,080 net tons.**

Steel & Wire Co. Neither has been blown in at this writing.

With 3,790,365 net tons of additional capacity available to pig iron producers during 1942, actual production rose 3,969,199 tons over the amount produced last year. Much of the nation's total of 60,031,709 tons of iron produced this year was due to the ingenuity and heroism of the men who make pig iron.

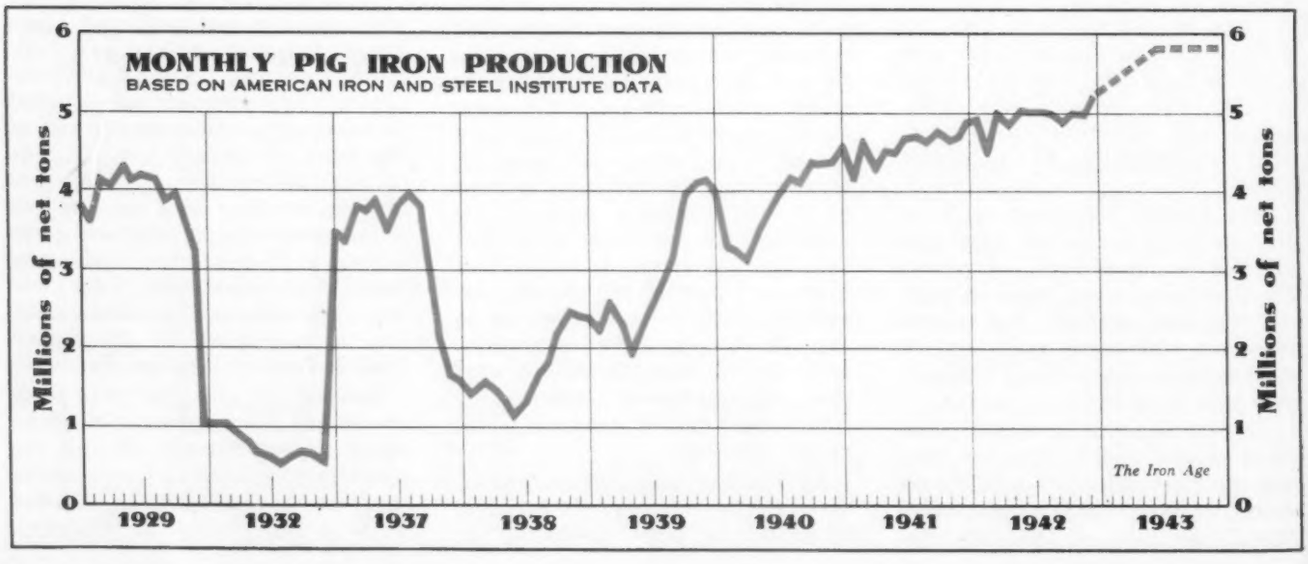
Praised for their bravery by the Army were the eight men of the Hamilton plant of the American Rolling Mill Co. who repaired the vortex of the No. 1 furnace while the structure was still producing pig iron. The careful planning on the part of the company's engineers insured the safety of these men.

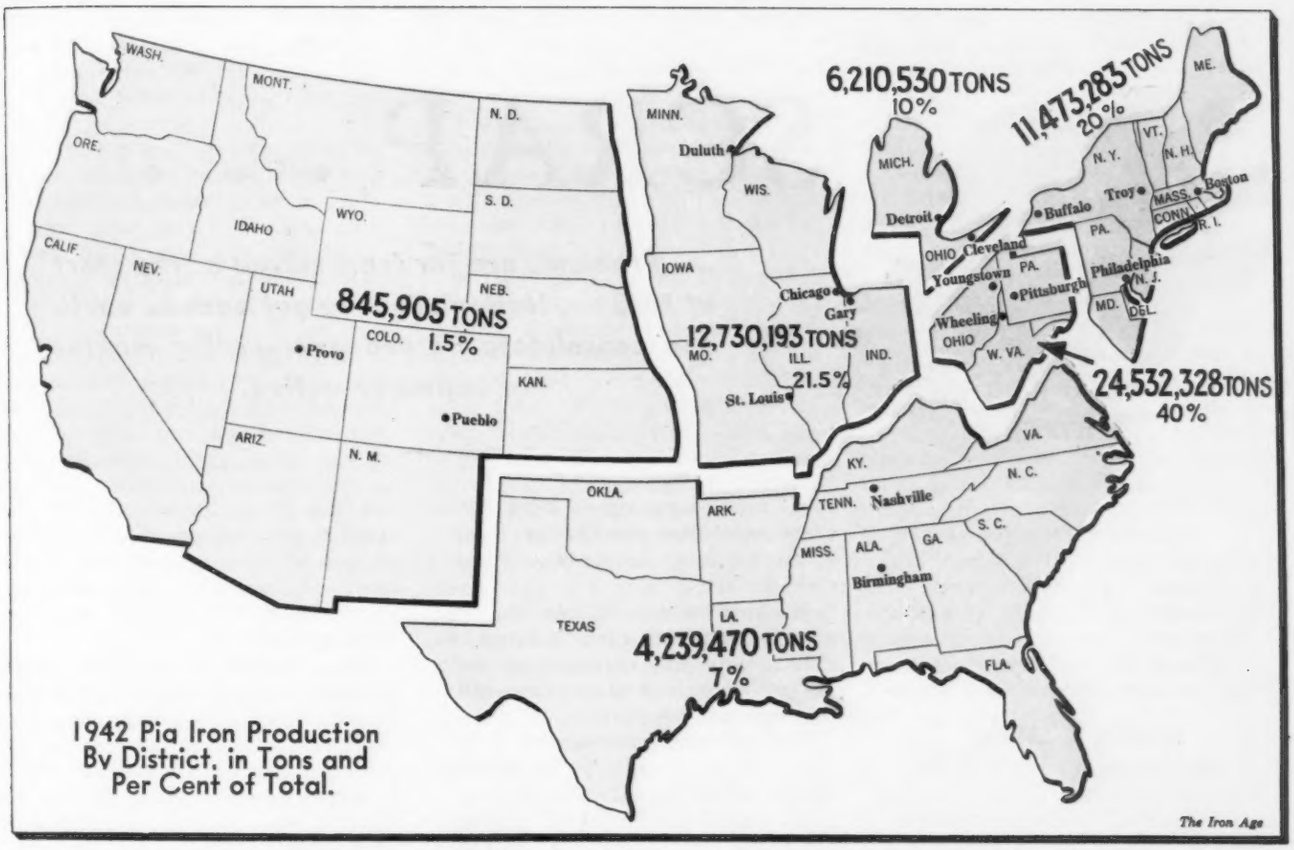
Another example of this unrated, unforeseen capacity occurred last summer at the Campbell Works of the Youngstown Sheet & Tube Co. By the use of a new device in constructing its D blast furnace, 94,500 tons of pig iron were saved. While the old furnace was still operating, a steel shell was preconstructed on a trestle. At the last possible moment, the old furnace was blown out and dismantled and as soon as the old unit was cleared away, the new prefabricated furnace structure was moved 112 ft. and placed in its permanent position.

With production records smashed month after month, pig iron output reached a new peak in its history with an estimated total of 60,031,709 net tons, 99.3 per cent of capacity. Largest percentage gains were made in the Cleveland-Detroit and Southern districts, each rising 11 per cent over their 1941 operations. Cleveland - Detroit added 6,210,530 tons to the country's total; 593,798 tons over last year's figure of 5,616,732 tons. Operating at an average yearly rate of 102.8 per cent of capacity, the highest of the nation, 171,585 tons over rated capacity were produced. Partly responsible for this increment is the new world record set in May by one of the blast furnaces of the National Tube Co. in this area. This single stack produced 43,886 net tons that month, exceeding its own previous record established in April by 5285 tons and the previous world's record by 388 tons.

With Tennessee Coal, Iron & Railroad's No. 2 blast furnace at Ensley establishing a new tonnage mark in April and again breaking all previous records in June, furnaces in and around Birmingham made 4,239,470 net tons of pig iron in 1942, 433,012 tons more than last year. Several of the district's smelters were taken off for much needed repairs during the year, but were blown in in record time. Number 3 Ensley of T.C.I. was completely relined in 37 days after it had been blown out, 25 days after relining was started. Another Birmingham furnace was taken off for complete relining for the first time since it had been put into operation in 1914. The addition of two furnaces to the district's total helped increase available capacity for the year by 649,881 tons or about 20 per cent.

Next highest percentage increase occurred in the Eastern area, bettering 1941's output by 7.6 per cent. In actual tonnage this gain amount-





ed to 810,037 net tons, from 10,663,246 tons in 1941 to 11,473,283 tons in 1942. The blast furnaces in eastern Pennsylvania, New York and Massachusetts working at 96.6 per cent of capacity for the year made 3157 more tons of pig iron on 1941 capacity. In terms of percentages, this amounts to an increase in actual production of 7.6 per cent with a capacity gain for the year of only 6.8 per cent. Some of the highs in this area were set by Wickwire Spencer who proudly announced in September a gain of 75 per cent in 1942 for the first seven months of the year, and Bethlehem Steel Co.'s Lackawanna unit.

Working at 100.8 per cent of capacity, pig iron producers in the Pittsburgh - Youngstown district contributed a total of 24,532,328 tons, 1,467,959 tons more than a year ago. With the government determined to decentralize the steel industry, blast furnace facilities were increased by only 4.5 per cent, or 1,068,960 tons in 1942. By pushing existing equipment to the utmost, the district's old furnaces upped their output of 1941 by 398,999 tons.

Consistent record smashers were the Pittsburgh furnaces of Carnegie - Illinois Steel Co. and the Jones & Laughlin units, one of which had produced 3,205,916 net tons of pig iron on a single lining without repairs or patching. Relining of one J & L furnace was completed in 24 days. Bethlehem Steel at Johnstown, Pa., completely relined and enlarged a 1200 - ton blast furnace 21 days after the last iron was tapped from it, 40 days ahead of schedule. Thus an extra 45,000 net tons of iron was added to the district's total. To permit the blowing in of its new Youngstown blast furnace, Republic Steel kept its No. 5 furnace in operation until the middle of November, long past its normal life. As previously explained, Youngstown Sheet & Tube contributed 94,500 net tons, 90 days' production, by using a new technique in blast furnace construction. Another record setter was the Hamilton division of Armco which established new highs for three consecutive months. Initiated by the company's labor-management committee, a campaign launched in March met with such success that in the first month, the plant broke Armco's all-time high with a tonnage of 42,718 net tons. In April output was increased to 44,439 tons, and in June it rose to 46,030 tons.

Aside from the blowing in of Republic's new Youngstown furnace, the year's changes in the district's capacity included the restoration of a furnace at Chester, Pa., by the Pittsburgh Ferromanganese Co.; the enlargement of a Carnegie - Illinois unit at Rankin, Pa., by 131,000 tons annually; Jones & Laughlin's Aliquippa plant enlarged by 114,000 tons a year; Pittsburgh Coke & Iron Co.'s Neville Island, Pa., furnace by 40,000, and the above - mentioned Youngstown Sheet & Tube furnace by 108,000 tons.

Striving to conserve critical and scarce materials while increasing present facilities, Carnegie-Illinois in March started to dismantle two non - operative blast furnaces in the Pittsburgh area in order to provide essential parts to other blast furnaces now existent in the district. The availability of these parts from the old furnaces will make possible a rapid expansion of pig iron capacity by about 400,000 tons a year.

Chicago, second largest producer of pig iron, melted 12,730,198 tons in 1942. Working at an average rate of 98.4 per cent of capacity,

(CONCLUDED ON PAGE 190)

SCRAP . . .

. . . Problems are far from solved at the start of 1943 . . . Nation needs to get back to earth and consolidate its endeavors after months of impulsive action.

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By DON R. JAMES
Associate Editor, THE IRON AGE

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AFTER a most turbulent year, iron and steel scrap problems are far from solved at the start of 1943.

The push to get scrap, particularly good material, will have to continue. This important commodity cannot be obtained except through arduous labor on the home front. Sporadic, poorly planned campaigns must be replaced by effort timed and geared realistically to the needs of consumers to assure them a steady monthly flow of high quality material. The problems of scrap collectors and processors, especially the labor and cost angles, must be dealt with more sympathetically. An intelligent program is necessary for the segregating and reclaiming of high quality steel scrap.

In short, the nation has to get back to earth on the scrap situation after too many months of unintelligent, impulsive action and inept government administration. Endeavors must be consolidated but hysteria is non-essential.

Little by little the threat of a serious shortage was relieved in 1942 after valiant efforts by the entire country. The expected national deficiency never became an actuality, although occasionally individual stockpiles were exhausted temporarily. At the start of the year the supply was low, but in mid-November after much toil there was (temporarily at least) a fair supply of hard-earned material.

Mass inventory figures do not show actual destitution of scrap in 1942. Only the situation on one day per month is shown in available reports, however.

The fall and recovery of scrap stocks at steel mills is illustrated by the following *gross ton* figures:

Jan. 1, 1940	3,484,812
Jan. 1, 1941	3,516,996
Jan. 1, 1942	1,930,146
April 1, 1942	1,603,836
Nov. 1, 1942	2,909,076

Total scrap consumption in 1942 maintained a fairly steady month-by-month pace indicating annual absorption of approximately the same amount used in 1941, around 54,500,000 gross tons.

Consumption of scrap by open hearths, electric furnaces and bessemer converters during 1942 is estimated, using Bureau of Mines figures as the basis, at 41,000,000 gross tons, up about 1,500,000 tons from 1941. Steel ingot production at 77,152,210 gross tons, shows a 5 per cent rise. Open hearths used less purchased scrap in 1942, compared to 1941, but increased their home scrap consumption. Total open hearth consumption fell behind 1941.

The use of scrap in electric furnaces rose month by month in 1942, reflecting the advent of new melting capacity.

Electric furnaces used over 1,500,000 tons more scrap in 1942 than in 1941.

Blast furnace consumption apparently fell off in 1942 by 1,500,000 long tons. Under the practice adopted by some companies last year, the borings and turnings were turned over to open hearths instead of being used in the stacks as in 1941. The decline in scrap used by blast furnaces in 1942 is small in view of total pig iron production of around 53,600,000 gross tons. Foundry cupolas charged about 700,000 tons less scrap in 1942 against 1941.

Open hearths were using more pig iron in late 1942, the principal reason why more scrap was not charged in view of the 5 per cent gain in ingot output for the year. In some cases as high as 60 tons of pig iron was charged for every 100 tons of ingots produced. The total metallic charge was heavier by about 1½ tons in late 1942 for every 100 tons of ingots. No data are available on whether the yield from charged raw materials might be higher due to continuous high operation, but some authorities believe a per cent or two gain might have been made over the normal 11 per cent loss in metallics charged.

More sinter and cinder and scale were charged in 1942 than in 1941 by roughly 200,000 tons. An increase of around 100,000 tons in metal from iron ore was made in open hearth charges for the year.

Steel ingot capacity of 91-92 million net tons at the start of 1943 represents a rise of 3 million tons since last June, and the schedule for 1943 calls for 98 million tons' capacity in the latter part of the year. New blast furnaces are counted upon to make up for a larger share of the increased metallics requirements but all realistic authorities expect that the steel industry will need as much purchased scrap next year as in 1942 and that new scrap sources must be developed.

According to the program laid out for 1943, based on prospective higher ingot capacity, even with open hearths charging 56 per cent pig iron and with more ore being charged, the amount of purchased scrap needed will be a minimum of 14,304,000 gross tons, and perhaps

more will be required. However, since the program was laid out lend-lease shipments have been cut and several other changes have occurred.

The abandoned street car rails, ancient vehicles, mined slag and other accumulations which appeared last year won't be available again. Much steel has been shipped under lend-lease and much steel is being lost on fighting fronts. The ranks of junkies are reduced and the scrap industry is suffering from deep wounds caused by government regulations. The higher production of heavy steel products has cut the yield of steel plant home scrap slightly. Only 15 per cent of a forging billet stays in the mill as scrap; a 5 or 7 per cent ingot crop is a heavy scrap yield; plate output yields less home scrap, and so on.

The possibility of shortages of certain classes of scrap is quite real. High quality material always will be sought eagerly, particularly for electric furnace consumption. Poor quality scrap ties up furnaces unnecessarily and reduces tonnage output.

A foremost problem which was being tackled in 1942 and which will be emphasized in 1943 is the segregation of alloy scrap.

Constantly during the war, more armor plate has been required for planes and tanks, and more alloy steel has been put into vital parts of other equipment. Alloy steel output in 1942 jumped to 13 per cent of total steel output. The result from the standpoint of scrap has been an ever growing return of alloy steel turnings.

Mills cannot use alloy steel turnings of unknown analysis indiscriminately. In order to stimulate segregation at manufacturing plants much educational work must be done. Studies which will assist the program were nearing completion in late 1942.

In 1942 total scrap stocks, reported at the end of each month, showed a steadily upward trend through the year. Stocks at the end of 1941 were only 4,400,000 gross tons. At the end of October, 1942, total stocks were 6,260,000 gross tons. The steel industry at the end of October had total stocks of 2,909,000 gross tons.

The 1942 trends thus were entirely different than those of 1941, when iron and steel scrap underwent a sharp rise in consumption while at the same time there was a large decrease in scrap stocks.

Examination of the tables which accompany this article brings to light a number of other trends of interest.

A decline of No. 1 heavy melting scrap in the hands of scrap suppliers and scrap producers is shown over the first nine months of 1942. At the same time these suppliers and producers were piling up ever greater stocks of No. 2 steel, cast scrap and turnings and borings. The total amount of unprepared material increased.

A rise of scrap stocks in the hands of manufacturers is discernible, indicating higher war production over the nine-month interval.

Declining scrap stocks at auto wrecking yards are evident in the tables. About 3,000,000 cars were wrecked in 1942 up to Oct. 1, and on Dec. 1 the trade only had an inventory of 277,234 cars.

Consumer stocks of No. 1 and No. 2 heavy melting and most other grades except rerolling rails gained rather consistently.

The breakdown of scrap consumption by principal types of furnaces reveals that foundries over the nine-month period showed a declining trend in total scrap usage, but their percentage of scrap used in relation to pig iron gained. Open hearths used 48 per cent scrap until late 1942 when the figure dropped to 47. This compares with a 1941 average of 49 per cent.

For the first time, a measure of the scrap industry's capacity is deduced by adapting the Bureau of Mines data. In the nine-month period receipts from dealers-brokers and auto wreckers totaled 15,591,000 gross tons.

Also, for the first time, scrap production by railroads and manufacturers from January through September is shown. Railroads produced 1,695,000 gross tons; manufacturers produced 3,941,000 gross tons.

The statistical tables have been compiled from the Bureau of Mines monthly reports. Unfortunately, statistics covering this vital commodity have been poor until recently. One weakness is the lack of uniformity on the part of reporting companies. One company will report transactions differently than an-

TREND OF SCRAP STOCKS AND SCRAP CONSUMPTION

(In First Ten Months of 1942, at end of each month)

With Comparison of Pig Iron Stocks and Usage

(Gross tons—000 omitted)

(Bureau of Mines Statistics)

1942	Scrap Stocks at End of Month at Consumer, Supplier and Producer Plants			Scrap Consumption by Months By All Types of Furnaces			Pig Iron Stocks and Consumption	
	Stocks of Purchased Scrap	Stocks of Home Scrap	Total Scrap Stocks	Consumption of Purchased Scrap	Consumption of Home Scrap	Total Scrap Consumption	Stocks at End of Month	Consumption During Month
January	3,078	1,022	4,100	1,905	2,520	4,425	1,315	4,462
February	3,028	1,045	4,073	1,844	2,360	4,204	1,250	4,066
March	3,106	995	4,101	2,022	2,639	4,661	1,148	4,554
April	3,337	987	4,324	1,997	2,606	4,603	1,100	4,414
May	3,640	962	4,602	2,047	2,618	4,665	1,090	4,491
June	3,801	1,058	4,859	1,997	2,467	4,464	1,122	4,347
July	3,939	1,148	5,087	1,977	2,493	4,470	1,157	4,428
August	4,085	1,194	5,279	1,967	2,511	4,478	1,136	4,406
September	4,306	1,239	5,545	1,883	2,541	4,424	1,146	4,318
October	4,956	1,304	6,260	2,061	2,709	4,770	1,130	4,594
Total				19,700	25,464	45,164		44,080

other — inter-plant shipments, for example. Discrepancies surround synthetic scrap. Reports of dealers and brokers overlap, and so on. Lately the Bureau of Mines has been attempting to effect some of the more badly needed improvements. Discrepancies will be noted between totals in the accompanying tables. Statistics covering the various voluntary campaigns of 1942 are too meager and unreliable to carry any weight. The Bureau of Industrial Conservation has been hesitant to issue its figures.

Always the center of tumult, iron and steel scrap entered a new era of controversy last year when even the general public began beating the air in debates over our most unintelligently handled war commodity.

For months before the heat was applied to householders, supply difficulties had aroused concern. The necessity for building inventories for the current winter was recognized early in the year, but no progress was made. Automobile industry scrap was ceasing. Dealers' preparation costs were rising and were not adequately covered by the scrap price ceiling order. At one time tin cans were being charged into some open hearths; direct dealing between mills and scrap producers was increasing rapidly and one or two mills even tried furnishing labor for auto wrecking. The price schedule was revised several times and finally Order M-24 was amended to encourage building of inventories. OPA's court actions to force compliance with its regulations deterred the movement of much material.

Meanwhile, sporadic drives were tried here and there. Since this nation had exported scrap freely, covered it over in city streets, dumped it in slag heaps, etc., it was difficult for the public to appreciate the sudden scrap value of little Tommy's broken toy automobile.

Finally, companies of the steel industry came out with an educational advertising campaign, which aroused widespread interest and emphasized very strongly the mills' need for material. The American Industries Salvage Committee provided much impetus.

Then came the dramatic newspaper drive, a barrage of publicity which stirred the public deeply, so much so that it responded with 5,000,000 tons of heterogeneous scrap, an amount far above expectations. Processing and transporting this vast tonnage turned out to be very difficult problems. About 65 per cent of the household salvage was light iron, mostly galvanized and requiring bundling; 11 to 15 per cent was cast iron, and 5 per cent was nonferrous. The remainder was highly miscellaneous. In New York, over 2000 galvanized hot water tanks came out within a few days.

In some cities the failure to move public scrap promptly soon brought severe criticism from the public and the newspapers. Dealers cried out that much of the material was being rejected by mills. OPA did not relax its regulations to permit freer use of the scrap. Public officials began blaming each other for failure to think beyond the first stage of the campaign. Collection of dormant industrial scrap suffered because the public scrap hadn't been used immediately. By late November many a person hoped that somehow the material could be buried quietly or tossed into the ocean. At a New York meeting a group of experts devised a plan to melt the household salvage in cupolas, the resulting metal to be used as counterweights or ballast, freeing equivalent tonnages of iron or steel having better-known analysis.

Collecting at one time millions of tons of miscellaneous household salvage is now known to be a highly undesirable operation. In 1943 a more intelligent program will be followed, centering upon dormant industrial scrap.

Performance of the scrap industry in the face of obstacles was noteworthy all through 1942. The average work-week in 5553 scrap yards in September was 45 hours, compared with 42 hours in August. Two-shift operations represented the ceiling.

Given manpower for three shifts, the industry could handle as much as 30,000,000 gross tons per annum, but all through 1942 the No. 1 problem was obtaining and holding labor, almost an impossibility under the low ceiling fixed by OPA.

The highly individualistic industry has lost considerable of its prewar appearance. Gone are the days when dealers profited by swings in the market, by being specialists for certain consumers and by making money on hidden values in certain operations. In the views of many, the industry has become a processing industry and will not emerge from that condition upon the advent of peace. Yards are operating on a broader base and handling a greater variety of grades than ever.

Although kicked around for several years, the industry fostered the framework for expediting scrap from many dormant fields, according to documentary evidence.

CONSUMER STOCKS BY GRADES OF SCRAP

Purchased and Home Scrap

(On last day of each month)

(Gross tons—000 omitted)

(Adapted from reports by Bureau of Mines)

1942	Heavy Melting No. 1 Purch.	Heavy Melting No. 1 Home	Heavy Melting No. 2 Purch.	Heavy Melting No. 2 Home	Bundles Purch.	Bundles Home	Low Phos. Purch.	Low Phos. Home	Cast Scrap Purch.	Cast Scrap Home	Turnings and Borings Purch.	Turnings and Borings Home	Rerolling Rail Purch.	Rerolling Rail Home	Scrap Rails Purch.	Scrap Rails Home	Chrome-Nickel Stainless Purch.	Chrome-Nickel Stainless Home	Chrome Base Stainless Purch.	Chrome Base Stainless Home	SAE Low Alloy Steels Purch.	SAE Low Alloy Steels Home	Other Prepared Scrap Purch.	Other Prepared Scrap Home	Unprepared Scrap Purch.	Unprepared Scrap Home	Total Stocks at Consumer Plants Purchased	Total Stocks at Consumer Plants Home	TOTAL
January	377	268	241	62	145	19	220	46	478	164	170	40	56	....	93	5	3	13	1	7	47	135	168	159	68	85	2,087	1,003	3,070
February	343	268	248	62	125	13	214	47	499	185	167	42	50	1	77	4	4	13	1	7	40	135	158	153	57	84	1,883	1,014	2,997
March	320	238	278	58	119	15	212	51	534	170	173	44	41	....	80	5	4	13	1	6	43	127	182	161	50	76	2,037	964	3,001
April	314	218	382	68	120	11	217	56	592	177	174	41	40	1	89	5	4	12	1	6	40	126	192	149	63	74	2,208	943	3,151
May	370	221	465	63	125	11	240	55	669	176	185	38	33	....	71	4	4	11	1	5	44	135	198	133	87	74	2,492	924	3,416
June	430	287	514	74	154	14	248	59	731	193	196	34	19	....	83	6	5	13	3	5	60	154	217	137	90	80	2,750	1,044	3,794
July	433	289	503	80	154	14	270	67	756	245	214	33	21	1	83	4	6	12	2	6	71	161	223	148	106	99	2,909	1,133	4,042
August	433	289	503	80	154	14	270	67	756	245	214	33	21	1	83	4	6	12	2	6	71	161	223	148	106	99	2,909	1,133	4,042
September	433	289	503	80	154	14	270	67	756	245	214	33	21	1	83	4	6	12	2	6	71	161	223	148	106	99	2,909	1,133	4,042

April	314	218	362	68	120	11	217	55	362	177	193	196	34	19	....	71	4	4	11	1	5	44	135	198	133	87	74	2,492	924	3,416
May	370	221	465	63	125	11	240	55	669	176	185	36	33	....	....	83	6	5	13	3	5	60	154	217	137	90	80	2,750	1,044	3,794
June	430	287	514	62	154	14	248	59	731	193	196	34	19	....	....	83	4	6	12	2	7	71	151	223	148	106	90	2,909	1,133	4,042
July	431	289	553	74	173	13	270	67	756	245	214	33	21	....	1	93	3	6	12	2	7	76	151	227	166	103	87	3,044	1,179	4,223
August	433	303	600	87	177	13	283	65	799	249	225	35	30	....	1	93	3	6	12	2	7	76	151	227	166	103	87	3,044	1,179	4,223

CONSUMPTION OF SCRAP BY PRINCIPAL TYPES OF FURNACES

(Gross Tons—000 omitted)

With Comparison of Pig Iron Consumption

1942	OPEN HEARTH FURNACES					ELECTRIC FURNACES					CUPOLA FURNACES					BLAST FURNACES			TOTAL CONSUMPTION OF SCRAP BY THESE FURNACES			Total Consumption of Pig Iron
	Purchased Scrap	Home Scrap	Total Scrap	Pig Iron	% Scrap Used	Purchased Scrap	Home Scrap	Total Scrap	Pig Iron	% Scrap	Purchased Scrap	Home Scrap	Total Scrap	Pig Iron	% Scrap	Purchased Scrap	Home Scrap	Total Scrap	Purchased Scrap	Home Scrap	Total Scrap	
January	1,127	1,767	2,894	3,137	48	181	208	389	5	99	387	320	707	407	63	100	138	238	1,795	2,433	4,228	3,549
February	1,082	1,624	2,706	2,911	48	184	217	401	5	99	376	315	691	386	64	97	125	222	1,739	2,281	4,020	3,302
March	1,203	1,857	3,060	3,220	48	192	223	415	5	99	403	336	739	392	65	99	129	228	1,897	2,545	4,442	3,617
April	1,150	1,817	2,967	3,154	48	208	228	436	5	99	404	333	737	372	66	106	133	239	1,868	2,511	4,379	3,531
May	1,224	1,857	3,081	3,230	48	210	238	448	6	99	380	298	678	339	66	119	135	254	1,933	2,528	4,461	3,575
June	1,175	1,721	2,896	3,129	48	210	220	430	7	98	385	300	685	338	67	106	142	248	1,876	2,383	4,259	3,474
July	1,167	1,760	2,927	3,202	48	218	228	446	8	98	369	291	660	328	67	113	129	242	1,867	2,408	4,275	3,538
August	1,143	1,796	2,939	3,273	47	223	233	456	8	98	369	283	652	307	68	124	124	248	1,859	2,436	4,295	3,588
September	1,070	1,822	2,892	3,213	47	219	230	449	7	98	364	284	648	310	68	119	129	248	1,772	2,465	4,237	3,530
October	1,180	1,938	3,118	3,444	47	252	248	500	8	98	385	292	677	319	65	125	144	269	1,942	2,622	4,564	3,771
Totals	11,521	17,959	29,480	31,913	..	2,097	2,273	4,370	64	..	3,822	3,052	6,874	3,498	..	1,108	1,328	2,436	18,548	24,612	43,160	35,475

STOCKS AT SUPPLIER AND PRODUCER PLANTS, BY GRADES

(On last day of each month)

(Gross tons—000 omitted)

(Adapted from reports by Bureau of Mines)

1942	SCRAP SUPPLIERS																				SCRAP PRODUCERS																TOTALS									
	Scrap Dealers										Auto Wreckers										Railroads										Manufacturers																
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
No. 1 heavy melting	79	52	59	58	31	26	31	29	28	..	3	3	3	2	1	1	1	1	1	..	16	15	17	17	22	19	17	16	17	..	12	12	11	13	13	13	12	11	14	..	110	85	90	90	67	59	61	57	60	..
No. 2 heavy melting	65	77	76	68	85	80	86	89	97	..	12	13	14	12	10	9	7	8	8	..	..	..	..	..	1	..	..	..	..	..	5	5	4	5	5	5	5	5	7	..	82	95	94	85	101	94	98	102	112	..
Bundles	25	25	28	27	35	29	30	30	31	..	3	1	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	7	7	7	6	6	7	5	6	8	..	35	33	36	33	41	36	35	36	40	..
Low phos.	16	17	15	15	17	18	16	20	20	..	..	..	..	..	..	..	..	..	..	..	1	1	1	1	2	1	1	1	1	..	6	6	6	7	5	5	6	6	9	..	23	24	22	23	24	24	23	27	30	..
Cast	49	50	55	56	65	66	66	66	74	..	7	8	8	7	7	6	6	6	7	..	7	6	8	9	9	9	9	8	8	..	2	2	2	3	4	3	3	3	4	..	65	66	73	75	85	85	84	83	93	..
Turnings & borings	18	20	18	20	21	21	21	24	27	..	..	..	..	..	..	•	..	..	..	..	4	4	4	4	5	5	4	4	4	..	11	11	13	11	10	10	10	11	13	..	33	35	35	36	36	36	35	40	44	..
Rerolling rails	12	12	11	4	3	3	3	4	8	..	..	..	..	..	..	..	..	..	..	..	19	21	18	17	20	19	21	20	23	..	..	..	1	..	..	..	..	..	..	..	31	33	30	21	23	22	24	24	31	..
Scrap rails	16	15	14	12	13	14	14	14	9	..	..	..	..	..	..	..	..	..	..	..	20	19	18	19	23	25	22	25	29	..	..	..	..	..	..	..	..	..	..	..	36	34	32	31	36	39	36	39	38	..
Chr-N Stainless	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	1	1	1	1	1	1	1	..
SAE alloy	3	3	3	3	3	4	4	4	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	4	4	5	3	3	8	..	4	5	5	7	8	9	7	8	13	..
Other prepared	32	33	30	30	29	32	27	28	22	..	6	5	5	4	3	3	2	2	3	..	30	28	31	32	34	35	33	32	33	..	6	6	6	8	7	5	6	8	9	..	74	72	72	74	72	75	70	76	67	..
Unprepared	293	316	328	374	392	402	388	391	439	..	106	112	111	96	80	65	59	55	57	..	28	27	33	35	35	32	33	35	32	..	30	34	32	33	37	26	25	24	26	..	457	489	504	538	544	525	505	505	554	..
Totals	608	620	637	667	694	695	686	699	760	982	137	142	142	121	101	84	75	72	77	93	125	121	130	134	151	145	140	141	147	146	80	85	84	90	91	79	75	77	98	101	951	971	994	1014	1038	1005	979	992	1083	1322

Intelligently directed, volunteer salesmen drives and industry-by-industry campaigns hold promise of giving desirable impetus to scrap collection efforts in 1943. For the kind of scrap the steel industry must have is the quality material, the heavy abandoned machinery and other industrial material offering high weight in proportion to its bulk when charged into furnaces and offering freedom from possible contamination.

The volunteer salesmen who joined the scrap drive in 1942 in a big way really began to do an excellent job on dormant industrial scrap.

Efforts to get dormant industrial material in 1943 will be assisted by the Associated Business Papers, forming a nucleus around which non-member papers will organize to promote a continuing, month-by-month drive through leading industries. Unlike the newspaper drive for household salvage, it will be built around actualities instead of being ephemeral.

In the opinion of some persons, well organized and directed volunteer groups like the salesmen could replace the costly government bureaus and achieve just as good results.

In 1943 the government is going to spend more money than ever procuring and moving scrap through subsidies. Low cost projects will be cleaned out first, and then higher levels will be attacked. Not only will large sums be spent in wrecking, but freight absorption will be necessary in some cases.

Some day long after the war is over, the total cost of scrap may be compiled and when all the expenses which the taxpayer is bearing are totaled, the conclusion probably will be that higher allowable scrap prices would have been a cheaper way to get material.

Plunging into the scrap supply picture and undertaking to direct the highly individualistic scrap industry, which had been bruised badly in its initial contacts with OPA, the government created bureau after bureau, each requiring many employees, most of them unfamiliar with the intricate problems they confronted. Enlisting the cooperation of industries, vertical setups were adopted in some localities where members of industries called on their own industry, while in other areas horizontal or geographical organizational setups were adopted. Occasionally, both methods were being used.

The degree of cooperation which the government received varied widely, depending on the ability of the regional salvage managers, whether they resorted to threats or gave genuine assistance, whether they discouraged new volunteers or extended a hearty welcome.

In New York an ambitious plan was laid out by the Industrial Salvage Section for calls on over 30,000 firms, when at the most only 10,000 had desirable scrap to offer.

In December, Washington officials began talking about the establishment of government stockpiles as insurance against any scrap shortage which might develop. Another Washington idea is that of equipping steel companies to process their own scrap. This was the theme of a statement last June by L. J. Rosenwald, chief of the WPB Bureau of Industrial Conservation.

The movement of scrap under absolute government direction, which reached a peak in late 1942, can be expected to continue for the duration, in varying degrees. Unfamiliar with the needs of the far-distant mill, the dealer does not like allocations because they mean a high percentage of rejections, which now cost about $2.50 per ton on the average against 50c. per ton in the "good old days." Nevertheless in late 1942, thousands of tons were being shipped from the seaboards to the interior.

A trend of considerable interest has been the flow of power from other branches of WPB to the conservation division of WPB. Indeed, in the opinion of some persons, some of the developments most upsetting to the scrap industry are laid to rivalry between the branches. A tug of war has been going on which flares into the open every so often. The conservation bureau, formed after the ill-fated aluminum drive, steadily has been growing bigger. At the start of 1942 many of the things the iron and steel branch was doing in 1941 were under the wing of BIC, including scrap procurement.

BIC's power was emphasized in late 1942 when War Materials, Inc., practically folded. WMI appeared to be going places (and the scrap industry fervently hoped it would be successful) in the drive to obtain demolition scrap and other difficult material. That is, it appeared that way until a day in October when WMI was deflated. Its imposing staff of scrap experts, many of whom (unlike the personnel in other branches) really knew a skull crusher from a hole in the ground, disbanded and the $500,000,000 bankroll (some claimed it was mythical) was snapped back into Uncle Sam's pants pockets.

SCRAP PRODUCED BY RAILROADS AND MANUFACTURERS

January, 1942, through September, 1942

(Produced purchased scrap)

(Gross tons—000 omitted)

1942	Shipments	
	Railroads	Manufacturers
January	181	341
February	171	346
March	187	408
April	175	433
May	181	428
June	174	477
July	188	464
August	206	489
September	217	529
Total Shipments	1680	3915
Plus stocks at end of September	147	100
Less stocks at start of January	132	74
Total Production	1695	3941

▼ ▼ ▼

Aircraft Developments, 1942-1943

By C. G. GREY
Surrey, England

. . . Never has a year been marked by so much confusion regarding design, construction and use of aircraft. Details are presented, balance sheets are drawn up, and the curtain of the future is parted slightly herein by the author, an observer known the world over for his skillful analysis of aircraft technology.

NEVER in about 35 years experience of aviation have I known a year in which there was so much development in the design and use of aircraft as 1942, or in which there was so much criticism and recrimination about design, construction and use. There is almost a military axiom in the statement that the Germans start every war with a perfect organization and get into a hopeless tangle if their organization breaks down, whereas those people whom we call predominantly Anglo-Saxon, which means the United States of America and the British Commonwealth always start in a hopeless tangle and somehow iron things straight at the finish and win. And the ironing-out process is complicated by the fact that neither the British nor the people of the United States like being criticized for what they are doing. Still less do they like the critics who say, "I told you so."

Our Mr. Churchill has said that the use of recriminating about the past is to assure efficiency in the future. In this article I do not propose to recriminate, but, if I do refer to criticisms it is merely to emphasize the fact that because of or merely after the criticisms remarkable changes have been made which have produced in the United States and in England a number of warplanes which are definitely the most efficient in the world. I use the word England on purpose because there are no Scottish, Welsh or Irish airplanes and no other of the British Dominions have produced any original designs.

There are many ways in which one might tackle the job of reviewing air developments. In fact one could easily write a book on the subject, but within the space available one must be as brief as possible. Therefore I propose to divide airplanes into classes and not into nations and discuss them under the headings of (A) Single-Engined Combat Airplanes, or Fighters, (B) Two-Engined Medium Bombers and General-Purpose Machines, (C) The Big Bombers, and (D) Sea-Going Aircraft. Also I hope to give a little space to future possibilities.

Fighters:

Among the fighters used by the Allied, or United Nations, the one machine which stands out at the top of the list for sheer performance and fighting and fire-power and maneuverability—which three qualities constitute what has become to be known as "weapon-value"—is the Supermarine Spitfire with the Rolls-Royce Merlin motor. It existed in its primitive form two or three years before the war began but it and its motor have been stepped-up year by year, almost month by month.

Its original eight machine-guns have become four cannon-guns, and in its 1942 development it is the fastest warplane in the world. Those types which have been modified for the purpose can fly higher than any enemy fighter, or bomber. Other types modified for extreme long-range reconnaissance are first in that class also. In sweeps over France, on escort duty to heavy bombers on short-distance raids, in the defense of Malta, in the defeat of the enemy in Libya, and more especially in completely smashing the superstition that the German dive-bombers are the outstanding menace of the war, the Spitfire has played a leading part.

The older Hawker Hurricane, which did most of the work in saving the British Army at Dunkirk and in the earlier stages of the Battle of Britain, has been doing its share of work during 1942 as a fighter-bomber, and it has struck out in a new line of business in that it has become a ship-borne fighter. When the Germans started using their big four-engined Focke-Wulf Kurier for Atlantic reconnaissance, finding our convoys, bombing them to a small extent, and signalling their whereabouts to the U-boat packs, the R.A.F. thought up the bright idea of catapulting Hurricanes from the decks of big merchant ships. One Hurricane could see off a Kurier, and several of the big craft were shot down. But the drawback to the method was that if a Hurricane alighted on the water almost invariably it turned over on its nose and killed or drowned the pilot. So the pilots soon took to baling out with their parachutes, with the result that every chase of a Kurier meant the loss of a Hurricane. But they did abolish the Kuriers.

Those Kuriers started from a big aerodrome near Bordeaux in the south of France, flew out round Ireland up to Iceland and round to Norway, where they have a runway something over two miles long from which they take off and fly on the reverse course.

Both the Spitfire and Hurricane are built entirely of metal with stressed skins of aluminum alloy which form part of the load-bearing structure. In fact the general structure of the small fighters of all nations is gradually approaching more nearly to the principle of a lobster's claw which carries all the load outside and has plenty of room inside, as differentiated from the structure of an animal which consists of a skeleton with skin outside. By the time one has put petrol-tanks, guns, ammunition and the needed operating gear for all three inside a wing there is no room for cross-bracing and little for any sort of skeleton.

Of the Hawker Typhoon, with the Napier Sabre engine, of which Lord Beaverbrook spoke so glowingly more than a year ago, nothing may be said, except perhaps that there are squadrons of it waiting for battle.

Newspaper readers will have learned most of what the various critics of American aircraft performance have had to say. And almost the unkindest critic of all has been the U. S. Government. Therefore nobody can accuse me of high-hatting, or of being patronizing, when I say that U. S. aircraft of all types, especially the fighter types, have improved wonderfully during the past year.

If only those U. S. Army Air Corps observers and Navy people, and more particularly the maintenance engineers of the U. S. aircraft firms who have been over here from the start of the war, had been able to put across in the United States what they learned here, a vast number of good American lives would have been saved, and Heaven knows how many tens of thousands of tons of first-class aircraft material.

Nobody has been able to criticize U. S. aircraft on account of their engineering design or construction. Their trouble has been either lack of speed or lack of armament. Every pilot I have known who has flown any U. S. airplane has always said that it was magnificent to fly. Controls have been beautifully balanced, the machine has answered to its stick and rudder perfectly. But, simply because the designers had not themselves seen the war at close quarters and because the real low-down about what was wanted had never been handed to them, all U. S. aircraft were lacking in weapon-value.

U. S. engineers have always been quick to learn, and U. S. engineering firms have always been ready to cut their losses, scrap the stuff which did not do its job and get going on something different. And that is what has been happening throughout the U. S. aircraft industry during 1942.

People who criticized the designs of American warplanes way back in 1938 and 1939 have since been accused of changing their tune now that they express their admiration of U. S. products. The critics have not changed their tune, but the U. S. aircraft industry has changed its products. And its products are going a long way towards winning the war.

For example, the Mustang, as it is called in the R.A.F. Army Co-operation Command, or the Apache bomber-fighter, officially the X.P.51 (North American Aviation, Inc.), is said to be one of the fastest and nicest machines in the war. It was intended originally to be a single-seat fighter, but the Allison motor has not as yet been stepped-up to fighting at high levels, but at its own height the Mustang is in the front rank.

Great things are expected of the Republic Thunderbolt P.47, which with a Double Wasp radial motor, seems to be putting up as good a performance as those with liquid-cooled motors.

Another in the single-seat fighter class which promises to be well up in the front rank is the Curtiss P.40 F. or Warhawk, with the new Packard-built Merlin, which is said to be well up to the highest Rolls-Royce standard.

The Lockheed P.38, known to the U. S. A. Air Corps as the Atlanta, and to the R.A.F. as the Lightning, has been greatly improved during 1942 and though it suffers from the height limitations of the Allison it is very fast at its own level. Whether its performance justifies the use of two engines and the twin tail booms remains to be seen.

. . . Peaceful indeed over the home countryside, but lethal over the seas around Midway. These three Navy bombers are not used to so much land underneath, their usual home port being the small heaving rectangle of a flat top.

Against this array of fighters the Germans' best seems to be the Focke-Wulf 190, definitely a development of 1942, in service, though the prototype has been flying for a year or more. With its four cannon-guns and two machine-guns it has a great deal of hitting power but its range is short and its duration of fire is also short. Consequently it is in fact a defensive weapon, designed particularly for the interception of our bombers. Officially its speed is 390 miles per hr. *for one minute* and its fighting speed at 20,000 ft. is about 370 miles per hr. And it fights up to 30,000 ft., possibly more. But even at its best height it is no match for the hotted-up Spitfire.

Another recent German development is the Messerschmitt 109 G. Like the Spitfire the Me.109 has been stepped up and up. The G. type has been met up to 40,000 ft., which is about the limit for any pilot who has only oxygen to breathe and has not actually a pressure-suit or pressure cabin. But the 109 G. only gets to that height

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by cutting down in armament. Incidentally, a pressure suit or pressure cabin is a risky thing in war for if an enemy punctures it the inmate bursts.

The only other enemy single-seater which comes into the upper class, although it is far from being in the first class is the Japanese 00, commonly known as the Zero. Perhaps I may explain that the figures 00 mark the Japanese year of that design. Our year 1940 is the equivalent of the Japanese year 2600, as their calendar happens to be 660 years in front of ours.

U. S. Navy pilots in the Pacific have said, according to reports, that if they had the Jap 00 instead of whatever they have as fighters they would chase the Japs out of the sky. And other reports say that the American Volunteer Group, which fought so well in Burma and China, made quite a good show of tackling the 00 with Curtiss P.40s (Tomahawks), which were already out of date.

The Japanese system of numbering is seen in another of their fighters, the Haichi Navy K.99 dive-bomber, which is therefore of 1939 design, and in the Mitsubishi G.97, which is their standard single-motor torpedo-dropper, of 1937, and is said to carry a 22-in. torpedo.

So much for the single-engine jobs.

Medium Bombers:

When one comes to the twin-motor jobs one is faced by the difficulty of distinguishing between fighters and bombers and fighter-bombers and medium bombers because the same machines so often do duty for all three jobs. For example, the Douglas Boston or A.20 C., and the Havoc II or A.26 are practically the same machine only that the Havoc has been specially equipped with a number of cannon-guns and machine-guns as a night-fighter and has particularly distinguished itself as what in this country is called an Intruder. That is to say these machines go over the Channel at night and catch the German bombers either taking off with full load or landing when the crew are tired after a bomb raid. During the past year the Havoc has in fact wrought havoc in this way and has been one of the most useful machines in the war. The Boston, on the other hand, is used for short-range, low-level bombing in daylight generally with a heavy fighter escort and it has also been most valuable.

The little Lockheed A.28 and 29, known to us as the Hudson, have been doing splendid service ever since the war started but like everything else it has been stepped up with bigger motors.

In this class the Martin Baltimore A.7 and Marauder B.26 have both been developed during the past year and the North American Mitchell B.25, of which little has been seen or said in Europe is, I believe, doing good work in the Pacific.

But in the two-motor class the De Havilland Mosquito stands out above all because of its terrific speed and maneuverability and range and load-carrying power. It is, I think I can fairly say, the fastest airplane in ordinary squadron service today. Primarily, its job was long-range, very high-speed photographic reconnaissance. Official communiqués have recorded that it has done fairly long-range bomb raids. And the press has been allowed to say that it can carry four cannon-guns and four machine-guns, from which one could deduce that without bombs it could be used as a high-speed long-range fighter.

The outstanding peculiarity of

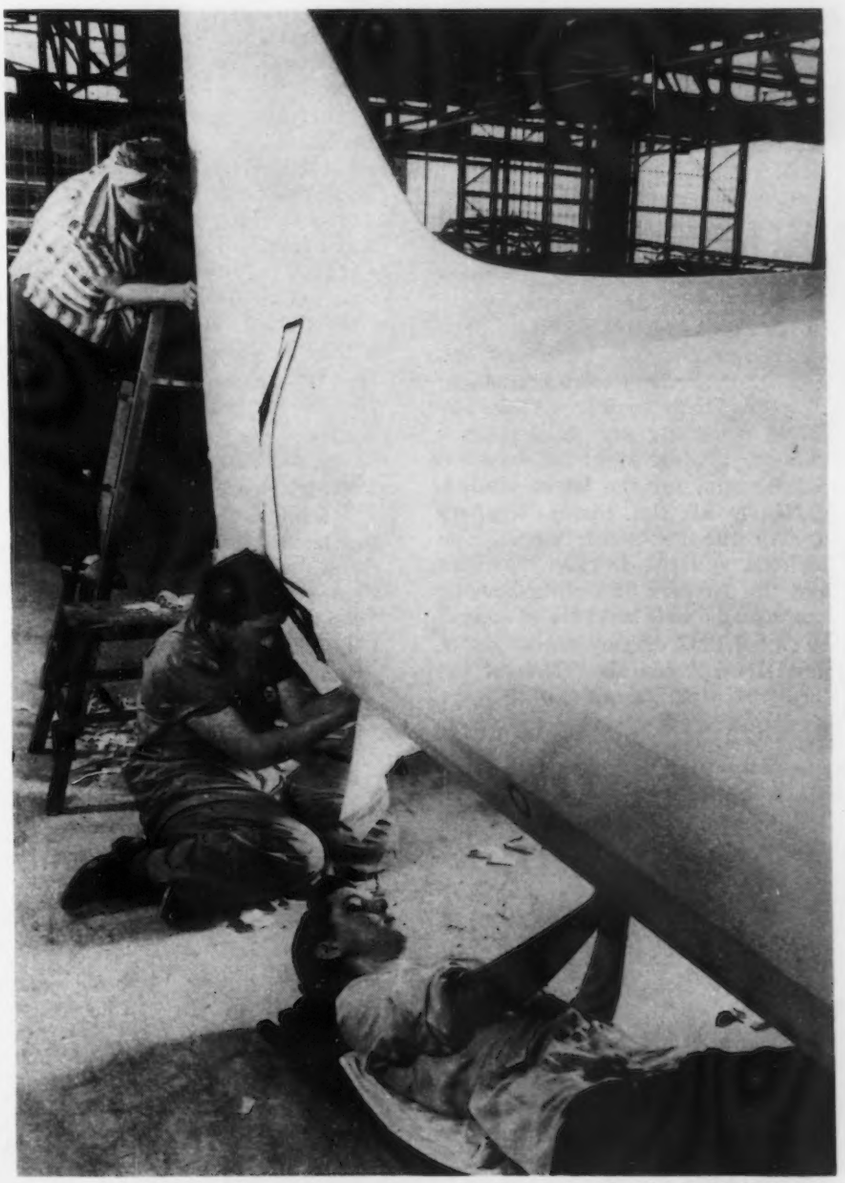

Photo by Richie for Fortune.

WOMEN putting the finishing touches on a Vultee Vigilant, a slow-flying, high-wing monoplane for observational liaison.

this machine is that it is built largely of plywood, which seems strange in this age of metal. For a long time many of us in British aviation have felt that steel and timber properly combined may well be as good as any combination of light alloys.

The Mosquito's two stepped-up Rolls-Royce Merlins give it just as much power in about as good a shape as any twin-motor job can have at present. And it is obviously a descendant of the De Havilland Comet which won the MacRobertson race from England to Australia in 1936 in 2½ days.

Although it has been in use for a couple of years the Bristol Beaufighter with a bath full of cannon-guns (four of them) and with ordinary machine-guns in the nose is about the hardest hitting fighter in the sky, and with the latest Bristol Hercules sleeve-valve engines, has about the longest range among fighters. Its fire-power is about 650 lb. of projectile per min. (at the rate of) against approximately 250 lb. per min. for the latest Me.109.

Nearly all the enemy bombers are in the two-motor class. The Heinkel and the Dornier bombers and the Junkers 88 fighter-bomber are already well known and cannot be called 1942 developments. But a new Heinkel, the He.177, is of interest. No photographs of it have been acquired up to November, 1942, but pictures of it have appeared in the German papers.

It appears to be a two-motor machine but in fact its two motors are Daimler-Benz 606 type which are in fact double engines of the 601 A. type. The normal D.B.601 gives 1050 hp. so the 606 should give something over 2100 hp. At the time of writing we do not know whether the engines which are of the normal 12-cylinder Vee in-line type are arranged with one inverted and one upright, so as to make an X-shape engine, or whether they are side by side and geared.

Another German development is the Dornier 217 E.2 which is small enough to come into the same class as the Bostons and our Blenheims, in that it only has a 66 ft. span but it is immensely heavily loaded and it is fitted with quick-release catches in the nose and under the tail which seem to indicate that it takes off with the help of some kind of winch gear to give it quick acceleration.

This would certainly seem to be preferable to the rocket-propelled start of the Ju.88, which has been used for the past two years and more. A Dutch friend of mine who escaped from Holland and now flies in the R.A.F. told me that few things are more terrifying than to see a heavily loaded bomber full of bombs and gasoline taking off at night with a huge rocket blazing under each wing, and knowing that if one engine cuts the whole thing will turn over and go up in one burst of flame.

Another new German development in this class is the Junkers Ju.86 P.1 or P.2. The original Ju.86 was a twin-engine passenger-carrying or bomb-carrying monoplane with two Juno 207 diesel motors. A couple of years before the war I flew from Tempelhof, Berlin, to Gatow-Kladow in one of them with several prominent U. S. citizens. Among them T. P. Wright of Curtiss, Lester D. Gardner and Ed. Warner.

None of the type has been identified as being used in bomb raids in this country but they have apparently been used as freighters. This new machine, the 86 P., seems to be intended for very high-level bombing or for reconnaissance, for it has been met, or at any rate

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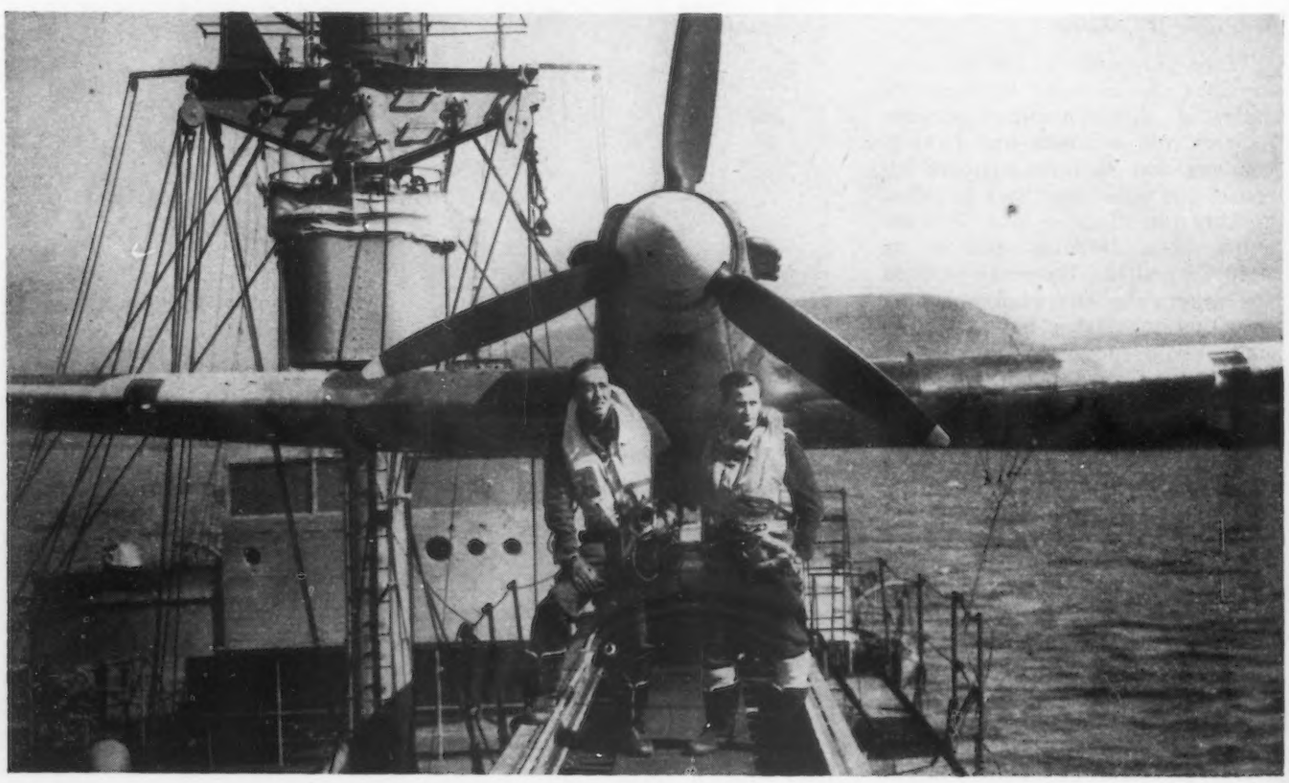
THIS Hurricane is catapulted from a merchant ship in order to intercept and shoot down enemy bombing planes attacking a convoy. Once the fighter is catapulted from the ship, the pilot is left to his own resources. He usually bales out and is picked up by a convoy escort ship. The Hurricane is, of course, lost.



THIS reconnaissance bomber is probably the fastest operational airplane in the world. It is the Mosquito and has two Rolls-Royce engines and is of simple wooden construction. It is the first operational type to be developed by the de Havilland staff since the war of 1914-18.

seen with a fairly powerful telescope I imagine at a height of something between 40,000 and 43,000 ft. The assumption is that it has a pressure-cabin and it appears to have a crew of only one.

The diesel engine would appear to have certain advantages for very high-level flying. In fact, the diesel engine, if it had ever been fully developed, would have had a great advantage in all kinds of flying. For one thing it would have saved the burn-up after every crack-up which seems almost inevitable in these days. And here I may remark that Sir Roy Fedden, who designed the original Bristol aero-engine and developed the Burt-McCollum sleeve-valve, which is used in the latest and biggest of all Bristol radial air-cooled engines, said four or five years ago that with £400,000 to spend on development, not on invention, he would guarantee to produce a diesel engine at as light a weight per horsepower as could be got for any gasoline engine. When one considers the number of people who have been burned up in gasoline fires one may suggest that the £400,000 would have been well spent.

Here I may say that in Italy much has been done to develop jet-propulsion, which means propelling the aircraft by projecting a stream of gasoline vapor backwards.

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Heavy Bombers:

Now we come to the four-engine heavy bombers about which there has been so much controversy. The first aircraft of this kind to be put into the air was the Boeing B.17, commonly known as the Flying Fortress, a misnomer because a fortress is essentially a thing which can defend itself and stand a lot of hammering. The original B.17 carried very little armament, and no armor.

In England at the same time we were developing the Short Stirling with four Bristol Hercules radial air-cooled engines, and the Handley Page Halifax with four Rolls-Royce liquid-cooled Merlins. At the same time A. V. Roe & Co., Ltd., commonly called Avro, were to be so successful and the Manchester which had two Rolls-Royce Vultures which were practically double Merlins in X form so it comes into the same class. Eventually the Vulture turned out not to be so successfu and the Manchester somewhat modified, in the light of the experience of other types, appeared under the name of the Lancaster with four Merlins.

Controversy rages about which is the best of the three aircraft. The Stirling is probably the slowest but it is said to carry the biggest load. The Lancaster, as the youngest, has the greatest refinement.

Somewhére about the same time the Consolidated B.24, or Liberator, appeared but it, like the Fortress, did not carry enough guns or armor. In the light of our experience in Europe both the B.17 and the B.24 were considerably modified and those of them which came to Europe in 1942 have turned out to be very useful warplanes. Those which came in 1941 or early in 1942, and were unfit for bombing operations on the Continent, were modified for anti-submarine work and have been doing excellent work in long-range journeys over the oceans, and that in itself may well be called a very valuable development of 1942.

At the time of writing the position seems to be that the Lancaster and the Halifax are very much faster than even the latest type of Fortress and at least as fast as the Liberator. They carry several tons more of bomb-load but against that they have not so long a range. And

because they carry a heavier load they cannot reach the extreme height reached by the Fortress.

And that brings us to another development of 1942. The big English bombers have been used almost entirely for the night bombing of Germany. Big-scale night bombing by anything between 500 and 1000 aircraft at a time is definitely a development of 1942. The chief protagonist of bombing as the cheapest way of winning the war is Air Marshal Sir Arthur Harris, Air Commanding-in-Chief Bomber Command, R.A.F. His theory is that if the German industrial districts can be hit hard enough regularly the destruction of the sources of munitions will so affect the efficiency of the German Army that they will soften at the front so that when the Allied U. S. and British Armies do invade the Continent of Europe their task will be no harder than was that of the Allied Armies between July, 1918, when the German Armies began to crack, and November, 1918, when the Armistice was signed.

Even the wildest enthusiast for air power would hardly claim that a war can be kept won by air power, although many will admit that air power will win it in the first place.

One interesting development also of 1942 was the success in October, 1942, of the U. S. Army Air Corps Liberators and Fortresses in beating off the attacks of German fighters in broad daylight with the 50-caliber machine-guns. So far the big American machines had made only comparatively short raids into French and Belgian territory occupied by the Germans, and then only with a heavy escort of R.A.F. and U.S.A.A.C. fighters.

Apparently the German fighters concentrated on attacking the big machines but enough of them mixed with the Allied fighters to keep them busy. But the Fortresses were well able to deal with the German fighters which got through to them and the enemy fighter met with a weapon which they did not expect.

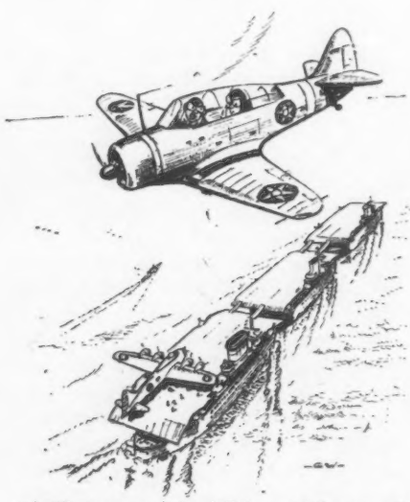
Just about this time a big force of Lancaster bombers raided the Creusot gunworks in France and did an immense amount of damage with comparatively little loss to themselves in broad daylight. They met little opposition while crossing Occupied France. By flying very low enemy fighters were unable to attack them from below, and when they attacked from above they were met by the multiple-gun turrets of the Lancasters.

One can thus foresee a time, not far distant, but possibly not during the worst of the winter, when raids will be made by large quantities of our heavy bombers night after night, and these will be followed by raids by the high-flying big bombers of U.S.A.A.C. which, although they will not be able to see the ground from 30,000 ft. in European weather, will at any rate be able to bomb industrial areas with some accuracy. At the same time there will be high speed raids by very large numbers of Mosquitoes with lighter bombs but quite big enough to smash any sort of building. And these again will be accompanied by low-flying raids by Lancasters.

In this way the industrial centers of Germany can definitely be hammered till they cease to be productive, and the German Army's front can be so softened that attack by the Allied Armies will not involve the ghastly massacres of 1916, 1917 and the early part of 1918, when practically naked men were thrown against barbed wire with machine-guns by the hundreds of thousands.

Air Transport:

The last great development of 1942 which in years to come will prove to be the greatest development that aviation has seen, is the organization of air lines practically all round the world. Before the war began Pan-American Airways had flying-boat lines across the Pacific to Hong-Kong, and land-plane lines all round South America and was opening regular flying-boat lines to Europe. British Imperial Airways had flying-boat lines to South Africa and to Australia. The Dutch K.L.M. had land-plane lines to the Dutch East Indies. And the French and Germans and Italians had their lines across the South Atlantic to South America. And all over Europe and the United States and Canada and Australia were networks of air lines run by great and small countries alike.



"I still say you can't bomb Tokyo with Fortresses."
—from *Aeroplane*

But 1942 has really shown what air transport can do. In 1940 George Woods Humphrey, formerly managing director of Imperial Airways, Ltd., started the Atlantic Ferry from Canada by way of Newfoundland to Scotland. During the cash-and-carry period the little Lockheed Hudsons were about the only things which could be flown across. Early in the Lease-Lend period a few of the early Fortresses came that way. Then as the deliveries grew Air Chief Marshal Sir Frederick Bowhill, who had built up the Coastal Command, R.A.F., went to Canada and took over the Ferry Command, and aircraft big and little began to pour across to us. Then Pan-American reopened, and British Oversea Airways, commonly known as the Boa, because it had swallowed all the small lines in England, reopened the pre-war flying-boat line between the States and England by way of Bermuda and Foynes in South Ireland. Later TWA began flying their Douglas D.C.3s by the Atlantic Ferry route.

Pan-American also developed a line across the South Atlantic from Brazil to British West Africa where it joined up with the branch of Imperial Airways which George Woods Humphery had started between Khartum and British West Africa.

Along that line big U. S. A. bombers began to pour into Africa to reinforce the British Armies in the Middle East.

During 1942 these Trans-Atlantic air routes carried a regular flood of American aircraft of every type which could cover the distance. Perhaps one may not mention the precise route although it was known to everybody connected with aviation in the U. S. A. before the States came into the war. Several years before the war the possibilities were discussed in print of a route by way of Newfoundland, Greenland, Iceland and Scotland, or alternatively to Norway.

Now these lines are pushing across Africa to India. In the other

direction they are going by flying-boat across the Pacific to Australia and New Zealand. In fact the length of the lines and the volume of traffic today, now under stress of war, is greater than air transport enthusiasts ever hoped to see in their lifetime before the war.

Most of the transport work is being done by the Douglas D.C.3, but the great Douglas D.C.4 (officially the D.54) with its four engines, is coming into use rapidly. There is a certain humor in the fact that the first D.C.4, which needed much modifying, was sold to Japan. The Curtiss Commando (C.46) with two 2000-hp. motors is also coming along.

Martin Clippers are doing much of the sea work and now the whole aeronautical community is awaiting anxiously the development of the Martin Mars and its production in colossal quantities by the great Mr. Kaiser. I am told that flying-boats were chosen because they eliminated the problem of designing under-carriages.

I have said nothing about Russia because nothing is known for certain of Russian development in 1942. The Russian censorship is stricter than any in the United States or the British Commonwealth.

Russian Aircraft:

One big Russian four-engine transport monoplane brought Mr. Molotov to a conference in London. Photographs do not suggest that it embodied any development of 1942.

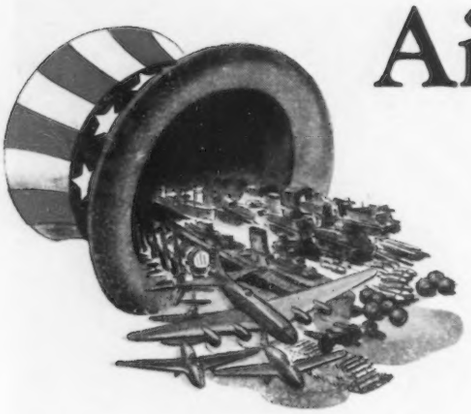
A good deal has been seen in the papers about a Russian bomber-fighter called the Stormovik. Photographs of it do not indicate any development either. The only novelty about it is that it carries under each wing two or three rocket bombs for ground attack. These are carried on rails instead of normal bomb racks. They are obviously fired electrically and are given their direction by sliding along the rails instead of dropping off as bombs do. Consequently, with their rocket propulsion, they carry on more nearly in a straight line with the course of the machine from the moment of their release than they would if they were ordinary bombs. But here again the Russian policy of secrecy, doubtless fully justified, has prevented any technical information from being let out up to November, 1942.

• • • A two-man riveting crew works on a B-24 wing section at Ford's Willow Run plant. This company has just started to deliver finished aircraft.

Mention of the rocket bomb suggests that as the subject directly affects aircraft design, something may be said about bombs and armament. At present the big English bombers are the only craft which can carry the 4000-lb. bombs, approximately three tons. There is interest here in noting that the late Brigadier William Mitchell in 1921 sank a surrendered German battleship and a cruiser off the coast of the United States with 2000-lb. bombs slung under the twin-motor Curtiss bombers of the period. Nothing as big as that was carried for 22 years afterwards, except possibly experimentally by one or other of the belligerent Air Forces.

The bomb enthusiasts are now talking cheerfully of four-ton and eight-ton bombs. They promise that even a four-ton bomb will completely abolish a city block. I venture to suggest that the sooner some of those bombs have been conveyed to the Japanese cities the sooner the war will be over. The policy of pushing the Japanese back the way they came through the jungle and across the oceans with the improved aircraft which may be expected in the next year or two, seems singularly futile compared with the comparatively simple operation of attacking Japan while its Navy and its Army are dispersed all over the Pacific. The development of adequate aircraft carriers and bombers by the U. S.

(CONTINUED ON PAGE 192)



Air Warfare Comes

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By THOMAS E. LLOYD
Cleveland District Editor, THE IRON AGE

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BORN of a sport in the late years of World War I, reared on the drawing boards of struggling one-man airplane builders, schooled in barnstorming flights at county fairs and air races throughout the world, and seasoned with crack-ups, crashe , and tragedies, military aircraft in the year of 1942 came of age. Today throughout the world, airplane builders, now no longer one-man affairs, for the first time have been permitted to abandon conventions set by peace-time needs and channel engineering, design, technical, and productive skill into fabricating the best air combat equipment in the world.

Aside from combat or military versions of aircraft in this fourth year of the war, there are few developments going on in the industry. True, many of the developments born of the war will be applicable to peace-time air transport, and, true, there are aircraft producers who are anticipating the end of the war, prepairing, at last on paper, for the planes that will be needed then. However, the engineering, design, production, and management brains of the industry today are focused sharply on the military airplane. The interest now is in keeping the best and greatest number of fighting ships in every theater of this World War II, and supplying the fighting units of this country and other allied nations with aircraft and material to set the stage for a knockout blow against the Nazis and Japs when the opportune moment arrives.

It can hardly be doubted that since Dec. 7, 1941, American aviation has taken a new lease on life. In 1942, thirty plane builders operating seventy plants built some 49,000 planes of seventy different designs, more planes than were produced in all the 23 years following the first World War, and aircraft tonnage tripled the tonnage of 1941. The value of planes sent to various war fronts in 1942 was $4,250,000,000, compared with $1,650,000,000 in 1941. Even with these production increases, the United Nations' air forces are still anxiously hoping for further help from American aircraft producers.

There has been dissension in this country on many phases of the airplane program. Arguments pro and con have raged on such subjects as air-cooled and liquid-cooled motors, diesels and spark ignition, and carburetors and fuel injection, as have discussions on optimum plane weights, sizes, maneuverability, range, speed and fire power, while the

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CONSOLIDATED'S new C-87 transport and cargo ship is an adaptation of its B-24 heavy bomber and is built at the new Fort Worth, Texas, plant. This ship is believed to be able to carry the greatest human or cargo load of any plane now in mass production. The ship, as may be seen, does not have the transparent bombing nose as does its counterpart the B-24, this space likewise being utilized for pay-loads.

# of Age

. . . In this fourth year of the war and the first of American participation, the aircraft industry's attention has been focused more on production than on new designs. Some 49,000 ships were built in 1942 and 100,000 is the 1943 goal. Material and manpower shortages are the major problems that must be licked to achieve this new quota.

potentialities of flying boats as against land based and carrier based ships have also run the gauntlet of criticism and argument, both official and unofficial. The industry has been criticized by Congress, WPB, and other official agencies as well as by the hundreds of arm-chair generals and admirals throughout the country. A tremendous and spontaneous interest has been aroused in the hearts of the American public in aviation; a generally healthy situation for the industry.

The de Severskys may argue until they are blue in the face that we should stop building aircraft carriers and build larger land-based bombers and fighters, and the Ziff proponents may resolutely contend that land-based airpower will deal the knockout blow. On the other hand, Naval experts such as Lieutenant Commander James Thach, who has seen considerable service in this war, will retaliate with demands for more carriers like the Lexington, Wasp, and Saratoga, which did yeoman work in the battles of the Pacific. However accurate either of these two schools of thought may be, a middle of the road course has been taken in Washington, and both jobs are in the process of being accomplished. There is universal realization that the American war program was late in getting started, but it is also realized in high government places that there is a definite need immediately for certain types of equipment, and it is the desire of the government to get as much of the right equipment as possible

ABOVE

AN expert milling machine operator is this young lady. She took a 90-hr. training course in one of the many special defense schools in Southern California and is now employed in production.

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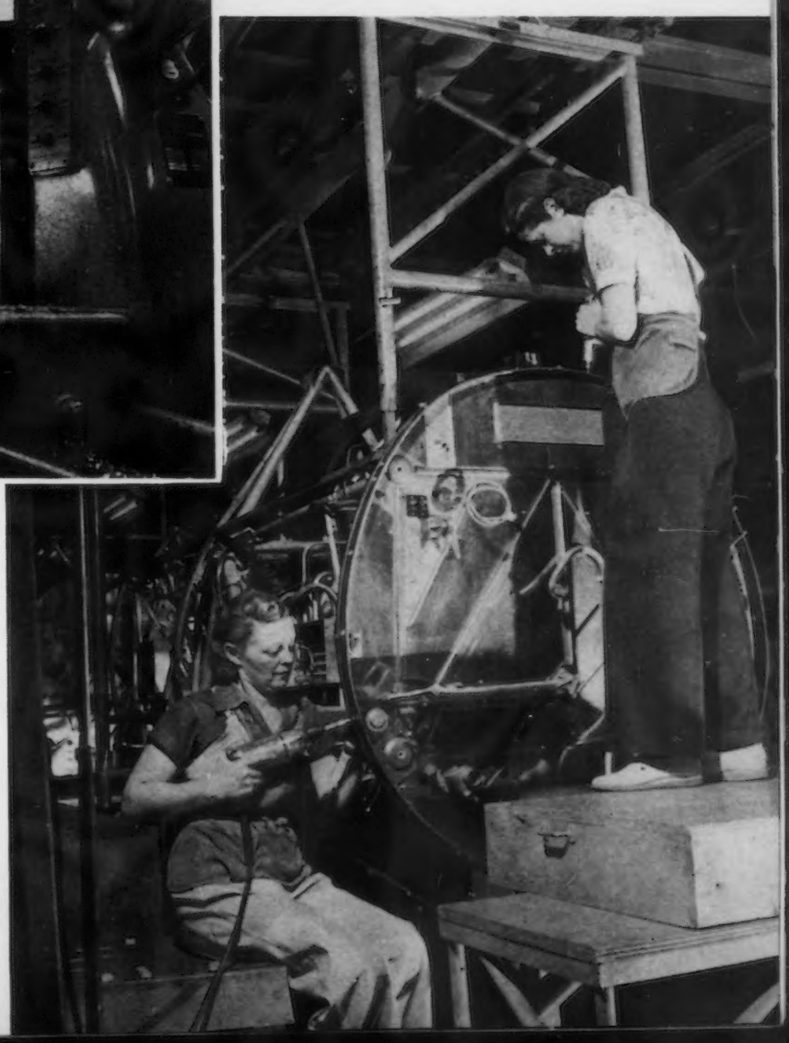


RIGHT

JOBS handled satisfactorily by women in aircraft plants are almost without limit. Here they are installing the fire wall, one of the timed units of assembly, in a Vultee basic trainer fuselage section.

in the places that it will do the most good.

The first question that would come of this line of reasoning for an aircraft program is: "How is the aircraft program coming along?" This is a tough one to answer, because in answering it not only the aircraft industry can be considered but the entire war program comes into the picture. If it were just a task of putting the planes together, the job would be simple, but planes are not built that way. They do not just originate in and evolve from the aircraft plant. Airplanes are, technically speaking, a product of every industry in the country; steel, aluminum, magnesium, textile, oil, copper, glass, plastics, and the many others. These raw materials are then shipped to literally thousands of shops and plants throughout the country for fabrication, machining, forming, processing, and many other operations before being delivered to the aircraft builder. To successfully carry out the aircraft program, then, all of American industry must be considered, and to ask how the aircraft building program is coming is to ask how all of the industries are doing that are engaged in war production.

Government Controls

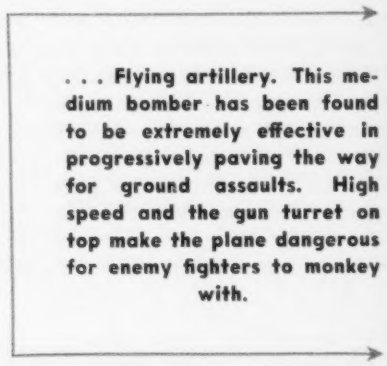
Still, a quick glance at what has happened in the year 1942 in the aircraft industry from the standpoint of government control is interesting. The President set the goal of 60,000 planes for 1942. That goal was not attained. The best that can be expected for the year, according to OWI, is 49,000 ships of all classes. However, the President in October interpreted his original goal of 60,000 ships to mean that production by the end of the year was to be at the rate of 60,000 planes a year. This goal was attained as early as July of this year and is at present believed to be substantially above that rate of production.

The biggest problem of the industry, early in the year, was material shortages, and as the year drew to the half-way mark another acute situation developed—manpower. Now, both material and manpower shortages are major problems faced by the industry. As production schedules went up, these shortages became more acute, and WPB and other governmental agencies could do little or nothing about them. The "manpower commissions" fumbled around for months and even now have set no definite and constructive policy on the problem from an industry front supply standpoint. As to materials, it was only within the past two months that definite and constructive policies were evolved.

What has been done to aid the material situation in the early months of the past year was done largely by the manufacturers themselves through their own perseverance in Washington and their ingeniousness at home. One of the most constructive and helpful developments was the organization, of two Aircraft War Production Councils, one that included West Coast builders and the other made up of East Coast manufacturers. The West Coast organization was founded in April, 1942, but the East Coast group is still so new that the polish has not yet worn off and the bugs have not yet been worked out. The West Coast council was developed to afford complete and honest cooperation between the various members, a program which, in reality, has made the member companies one large organization divided into plants which produce the various types of planes. Materials, engineering help, technical help, and practically every phase of aircraft production information are being interchanged with no reservations by the member companies. In emergencies, materials are "loaned" or "sold" by one producer to another. Furthermore, employee training information and engineering training information have been pooled. Such cooperation between competitive organizations has heretofore been unheard of in American industry, and five years ago would have been considered impractical and an idle dreamer's fantasy. Now, however, it is working and doing a fine job. The East Coast council, likewise, will be operating in the same manner within a short time.

Aircraft Now A "Must"

More recently, the supply situation has eased somewhat, because there has been an about face in Washington on the airplane production program. Before the middle of last November, the program was just another part of the entire military scheme and by some it was considered a minor part. Before the Army and Navy Munitions board, the aircraft industry really needed a friend in court, because the board's production emphasis was on other phases of the war. However, the announcement of a supreme board to handle aircraft production by WPB Chairman Donald Nelson, marked the turning point. This announcement took the production authority out of military hands, which from a production standpoint are not to competent, and put it under civilian command. The Aircraft Board, consisting of four men, was announced Nov. 19, and was given indisputable authority over the warplane construction program, marking the first direct action by WPB to hold a tight rein over war production. The move served to elevate aircraft production to the "high ranking must" stature that it didn't have in the past. The "stepchild" of the arms effort came of age.



. . . Flying artillery. This medium bomber has been found to be extremely effective in progressively paving the way for ground assaults. High speed and the gun turret on top make the plane dangerous for enemy fighters to monkey with.

Almost immediately, planes were at the top of industry's "must list" and began to take precedence in conflict for materials with other weapons. Furthermore, the change of emphasis from one type of weapon to another showed that U. S. industry is as maneuverable as the strategy of the armed forces. Raw material producers, subcontractors, fabricating shops, and all of the associated industries were given the "green light" on aircraft production and plane builders all felt the weight of WPB's efforts in that material and equipment were no longer such a problem.

Cargo Planes

One of the changes in WPB policy that occurred simultaneously or slightly before the announcement of the WPB Aircraft Board was that concerning cargo planes. As early as July 21, WPB Chairman Nelson advised "against undue optimism about the construction of cargo planes of any type," after examining a report by a technical committee appointed

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to look into the matter. The committee studied the question from all angles; fuel supplies, conservation of strategic materials and the relative efficiency of various types of cargo planes. While the committee report was never made public, it can surely be assumed that it was not highly favorable to the expansion of cargo plane building facilities in the light of subsequent developments.

However, the question was continually raised in Washington and trial contracts were let to some builders who proposed to supply cargo ships. After much bantering around, however, by Martin, Kaiser, Higgins, and others of their school of thought, the air cargo ship was finally deglamorized, if not de-bunked and emphasis was put on fighting ships. Cargo and transport planes have a place in the war, and sufficient quantities will be manufactured to meet these needs. The Fort Worth plant of Consolidated Aircraft Corp. has been quietly turning out cargo ships, shown in Fig. 1, a variation of the B-24 heavy bomber, since April, 1942, as has Curtiss-Wright, perhaps a little less quietly, to mention just two cargo plane builders. However, the idea of transporting everything by air, as urged by many, is out of the question. The folly of substituting air freight for water shipping is at least realized, the idea being an evasion rather than a solution of the problem of submarines.

The new 1943 program evidently does not include expansion of air cargo construction facilities. The Nash-Kelvinator contract to build flying cargo boats at a Gulf Coast plant was cancelled and other similar contracts are expected to get the axe. This is spectacular evidence of the change in war strategy, indicating a growing belief that waterborne vessels can and will do the bulk transportation job in this war, and is a definite setback to expectations in some quarters that the flying freight train system would be highly developed by the war.

Manpower Shortages

With the material problem of the aircraft industry solved at least temporarily by the action of the WPB, there still remains one vital factor that may limit future plane production. That, of course, is the manpower available to the aircraft industry. With enlistments and the draft drawing off the cream of the aircraft workers that have been with builders since before the war, privately admitted by bigger builders to be at the rate of 100 men per week, and with plants and factories being expanded greatly, the problem is becoming more acute daily. Upgrading of men capable of supervisory responsibilities has proceeded much faster than normally would have been the case and seasoned supervision and management have been saddled with increasing responsibilities. The management man who today works seven days a week, from eight to fourteen hours a day, is typical rather than the exception. Many men who were on the production line a few years ago have become foremen, plant managers, superintendents, and even executives in this expanding industry. Management has been spread very thin and in some spots is considered by the builders themselves to be too thin for optimum operation. Men who knew their jobs were promoted fast and when they reached the higher job brackets were not to familiar with company policy, general supervisory knowledge, and the many other phases essential to good management. However, these were the only men available who had any knowledge of the aircraft industry and they had to be chosen.

COMMANDING the top wage among women employees at Vultee, this woman earns close to $70 a week, being an old hand at welding. During World War I she welded crows-nests for battleships and has wielded a torch in structural steel work in multi-storied buildings. She is married and works because she has "a skill that can be well used to bring victory closer."

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As to the actual producing personnel, that is still another problem. Thousands of new recruits had to be brought into the industry from all walks of life and trained to assemble airplanes. They had to be trained to do the many jobs necessary in assembly, sub-assembly, metal forming, machining, and other phases of the program. This was a gigantic task, this training, and had to be met immediately. Consequently, to meet it most efficiently and quickly there was one definite policy established. That policy was **downgrading** of the work rather than **upgrading** of the employee. Jobs were broken up into their component parts and employees were trained quickly and well to do one or two jobs, rather than to do a variety of jobs. The employees were not trained for variety in the work, but were specialists on specific jobs.

Another factor affecting production personnel was the influx of women into the industry. Beneath the glamorous and sometimes thrilling reports of women at work building airplanes were some highly substantial grounds for the surge of women workers into the industry. In March, 1941, the California aircraft industry employed less than 500 women. The bulk of the male workers were, however, within the Selective Service age range, with the median age well under 30 years. Consequently, when these men began to leave for the armed services, both through enlistments and induction, there was only one labor reservoir adequate to fill the demand, which, of course, was increasing. While at first the industry felt that it was hiring women because of their greater ability in manual skills requiring dexterity, there was a quick realization that practically no job done by men couldn't be done as

THE two-place Ryan PT-25 primary trainer is an entirely new military ship in design, construction, and materials. The Army advocated the use of less scarce materials and this plastic-bonded plywood ship was developed to eliminate use of all critical materials in its fittings and structural parts.

well by women. Also, the early fear by unions that women workers would lower the general wage scale has now almost been completely dissipated.

Women Hiring Great

It has been found almost universally that women are serious about the work, industrious, adaptable to most work, and thoroughly competent. Figures of female employment are sufficient proof of this. The California Division of Labor Statistics and Law Enforcement show that the aircraft industry in that state employed about 18,000 women as factory wage earners in June, 1942, compared with 12,000 in May and less than 50 in February, 1941. These figures compare with a total of 29,000 women in all California durable goods manufacturing industries in June and 22,000 in May. On Sept. 1, 1942, Boeing claimed top honors with about 26 per cent of its employees women, Vultee had about 21 per cent, and the industry as a whole was between 12 and 15 per cent women. At the end of the year the proportion of women in the West Coast airplane industry approximated 35 per cent, and the proportion of women among the trainees was nearly 70 per cent. At the same time, it was estimated that the payroll of Niagara Frontier plants of Bell Aircraft Co. was made up of about 50 per cent women workers and the proportion was still increasing.

As to the work that women have been doing in the industry, the jobs are many and varied. Women machine operators, electrical and radio wiring installers, arc and gas welders, assemblers, inspectors, timekeepers, stock clerks, sheet metal workers, and riveters, as shown in Figs. 2, 3, and 4, can be found in any aircraft assembly plant in this country. They came from all walks of life to work in the aircraft plants. Pay rates are as high as when men did the job, and it is honestly believed that the efficiency of women is higher than that of men.

Naturally, to hire women in wholesale numbers and bring them into aircraft plants, a tremendous training plan had to be inaugurated. Apprentice training courses are now set up in practically all plants, but in the beginning it was more a question of bringing women with little or no previous training experience into the plant in small lots and putting them to work under supervision. Many factory processes were broken down to smaller, lighter jobs, and these were handled by women. The girls were teamed with experienced male workers and their adaptability in picking up the new job was often astonishing.

Now, complete apprentice training programs take care of the training of the new workers. For example, Lockheed Aircraft Corp. and Vega Aircraft Corp. maintain formal apprentice training courses, and the Glenn L. Martin Co., which on Sept. 1 was hiring women at the rate of 500 a week, has nine local defense vocation schools to provide the training needed and advanced engineering courses are being presented at Johns Hopkins University, the University of Maryland, and the University of Baltimore. Early in December, a school for training employees to staff the new Fisher bomber assembly plant at Cleveland was formed with courses offered to prospective employees designed to train them in the wide variety of jobs in assembling the new Boeing B-29.

The plane producing business has taken on the status of a feminine career, and it may not be long until the percentage of women aircraft employees approaches that of Britain, 60 per cent of the industry. It is only a question of time until women also step into the engineering end of the business and take over some or all of the 29 different classifications of engineering jobs. Consolidated Aircraft Corp. already reports that its experimental engineering departments have been taking girls with technical training or aptitude off assembly line jobs and putting them into departments where they work along with engineers and technicians. The aircraft industry throughout the country has realized the potentialities and capabilities of the woman worker and this huge labor reservoir is being tapped as fast as it is possible to assimilate women into the plants.

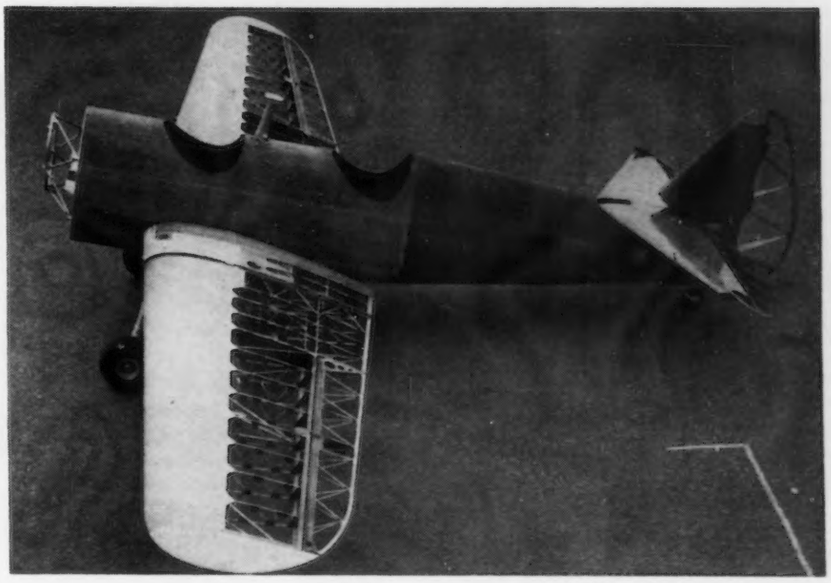
Often during the year when builders took on the necessary additional personnel to meet production schedules and proceeded to train these workers, the situation arose where there were more people in the plants than there was work to be done, that is, work to be done by competent employees. The result was frequently a state of confusion and persons who saw only the large number of idle workers were often quite critical. By the end of the year, however, the situation relieved itself The influx of green help has been to a very large extent assimilated with a consequent healthy rise in plant output. This condition will put a halt to the denunciations about factories crowded with idle workers as made by self-appointed critics of the industry.

Labor Problems

With a manpower picture that has not been too rosy with the industry, there has also arisen during the past year a variety of labor troubles. Demands for increased wages, unionization drives, opposition to management, demands for a

voice in management, a voice in the Aircraft War Production Council, and opposition to the wage stabilization program have all dogged the already harried management. In April, the appearance of one of the industry's strongest AFL unions on the West Coast in the CIO camp to join in the battle for extended representation in management surprised the industry. The CIO United Automobile Workers, attempting to organize the industry, had heard of the plan by the manufacturers for the Aircraft War Production Council. Before the manufacturers who were forming the council could announce it, the UAW publicly suggested the formation of such a group. The plan suggested by the CIO-UAW, however, differed from the inter-company council in that it included a substantial labor representation. Upon closer analysis, stated one observer, suspicions were aroused that Detroit's Walter Reuther plan which had been knocked on the head by General Motors' C. E. Wilson, had been exhumed from its restless grave and transported to the coast. The aircraft companies, however, ignored the UAW's plan and went ahead and announced the inter-company Council as originally worked out, without labor representation. Immediately, the joint AFL-CIO "production for victory committee" lost no time in terming the management council "a step in the right direction" but said that it was deeply perplexed at the failure of management to make a place for labor representation. However, the Council is still operating, now more efficiently than ever, without the dubious aid of unionized labor.

Antics like this were not uncommon in the aircraft industry throughout the year. Massed pickets patrolled the Detroit plant of the Murray Corp. of America proclaiming that they were laid off while the plant slowed production on one type of aircraft and tooled to produce another. In other words, they protested a model change in this plant. Willow Run has shared heavily in labor difficulties. Materials going into the plant were held up at the gates by petty union squabbles. One instance was that the supplier whose equipment for airplanes was not a union shop, and the UAW permitted the equipment to go into the plant only after UAW members in the Ford plant took off one or two small gadgets and then put them back in place, so that the work was done by unionized labor.



THE new Ryan plastic-bonded plywood PT-25, primary trainer is a very close approach to complete elimination of strategic materials. Except for the engine cowling, no forgings, castings, extrusions, or critical steels are used for any fittings or structural parts.

And so on, throughout the year, trouble brewed and boiled with labor and unions in the aircraft industry, much as it has in many other war industries, but probably a bit more noticeable because of the criticalness of the plane production picture. Flushed with success at the quick and efficient organization of the Ford workers in Detroit, William B. Taylor, famed CIO-UAW organizer, arrived on the West Coast in May to bring the CIO's brand of salvation to the aircraft industry. He worked as skillfully as possible on Douglas employees and other plants, but apparently lacked the finesse necessary to convince the uncivilized workers that the CIO was their manna from heaven.

While still on the subject of Detroit, even though it was brought into the picture because of its labor problems, there is something to be said on its productive ability in so far as aircraft is concerned. It will be recalled that it was Detroit's famed mass production automobile industry that was going to show the world, and especially the American aircraft industry, how to build airplanes. With all of its mass production, engineering, and technical knowledge, Detroit, before the year 1942 was passed, was to be the center of the aircraft industry. The best that can be said for Detroit on this score is: "Talk is cheap." Detroit is no nearer to being the center of the aircraft industry today than is a whistle stop on the B & O.

While Detroit has done a good job in producing many aircraft parts and sub-assemblies, the production of completed planes is fiction not fact. Willow Run, the Ford bomber plant, became widely known as "Willit Run," and it was not until early December that it was announced that Consolidated B-24 bombers were being delivered to the Government from this plant. Willow Run production, now scheduled to reach its peak during the latter half of 1943, is just about one year behind the original peak production schedule.

The auto industry almost to a man smiled tolerantly and cynically at the early efforts of the aircraft industry to get under way on heavy production schedules, but today the aircraft industry can afford to laugh last because it is doing a man-sized job while Detroit is still floundering around, enmeshed in its own peculiar labor troubles and production problems, many far afield from the aircraft program. It cannot be said that Detroit hasn't tried to make itself the center of the industry, but apparently it just didn't have the stuff to compete with already established competent and intelligent aircraft management and engineering skill. It had best stick to its first love, the automotive requirements of the war, and leave the aircraft picture to "them as know how."

While the war rages all over the globe, there has still to be found

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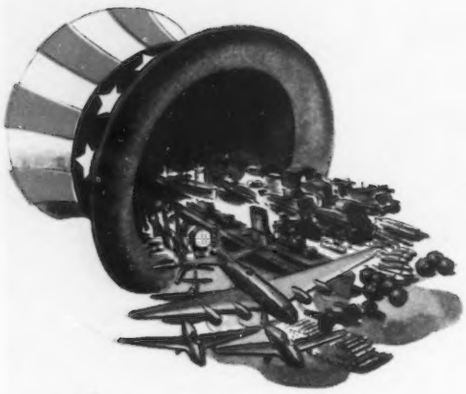

METALLURGY AT WAR

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By W. A. PHAIR
Western Editor, THE IRON AGE

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. . . Shortages, obscure elements, and ornery gases drop into place in the metallurgical jig-saw puzzle, building a picture that includes NE steels, "needling", light metal protection, and use of tricky scrap.

METALLURGICAL progress is never a clear cut movement, but rather a thousand small movements taking place in a thousand different plants. One piece of this jig saw puzzle is fitted in this plant, while the next piece is fashioned in a plant thousands of miles away a year later.

From close range these individual efforts appear very much disconnected, yet actually they are all part of a bigger effort, an end achievement some times so great as to be beyond the sight of contemporaries. Yet, when all these little parts are finally fitted together in a master pattern, a new science is born, or a new material created.

The efforts recorded in this report are all part of that picture, small parts of the larger puzzle, each contributing in some manner to completing the picture.

In this necessarily incomplete report, it is intended to point out the general trend of metallurgical research over the first year of World War II, and to suggest some of the newer trends in metallurgical thinking.

The scope of metallurgy today is difficult to define. It extends well into the sphere of actual use, particularly under the lash of war demands. Yet, in war time, laboratory conclusions must often be the field conclusion. Time and the needs of military strategy often do not permit the normal interval of field testing.

This distinction between metallurgy at war and at peace is vital. It is the difference between whether that shiny coating on a toaster will last 5 years instead of the guaranteed 10 years, and whether the enemy's shot will consistently pierce our armor plate and give rise to lost battles.

Much of the work metallurgists have been doing this past year has been of a nature that cannot be turned to public view. For example, the development of the steel cartridge case is one of the outstanding metallurgical problems of a decade, yet it cannot be discussed in detail. Another hush-hush job has been the new method of producing medium caliber gun barrels, which, if it could be discussed, might explain the abandonment last fall of two newly built centrifugal casting gun plants.

Some of this hush-hush work has important commercial aspects for after the war markets. Particularly outstanding are the die casting of magnesium, the new methods of copper cladding steel, the cold treatment of metals for better stabilization at high temperatures and for better shrink fits, the rolling of stainless steel to paper thin strip without intermediate annealing. Too, there is the growth of duplexing and triplexing operations which, though originally war time expedients, have important peace time possibilities, according to many observers.

From practical experience, it has been learned that the quickest way to get a metallurgist to commit mayhem is to ask him what he knows about NE steels. While this reaction is readily understandable, it does not detract from the fact that the development and acceptance of the NE steels has truly been a remarkable achievement. The work done by the various industry associations and publications and by individual metallurgists in testing these steels, correlating the data and distributing it to the metal industry has been of far greater importance to the prosecution of the war than is generally appreciated.

The NE steel situation was not without its humorous aspects. The loud wailing that arose from design engineers over the lack of pedigrees for the NEs comparable to those available for the SAE types certainly highlighted one of the holes in our modern industrial technology. Weaned on a superabundance of information, arising from the supercompetition of steel mills for customers, many user-metallurgists were quite helpless with the meager, but quite valuable data on NE steels which were available early last summer. This helplessness pointed out all too clearly that too many metallurgists lack a knowledge of the fundamentals of metallurgy and have relied too heavily upon tabulated test results, without actually understanding the values represented by such data. If

nothing else, the age of the NEs has forced many of our metallurgists to return to school again and this, in turn, should be reflected in a more sane use of alloy steels in post-war product design.

Too, this lack of a fundamental approach to the metallurgy of the NE steels on occasion gave rise to issues which grew from mole hills to mountains because of this lack of knowledge. Such was the case last summer during the to-do over the flaking characteristics of certain NE steels.

NE Hardenability

Few users of the NE steels appreciated the value of the hardenability curves which were among the first data made available on the NE grades. Too many overlooked the fact that all alloy steels follow a fairly constant natural pattern and that a wealth of information was readily available from these curves, and from simple comparisons with similar known alloy steels.

Perhaps the outstanding contribution toward a better understanding of the NEs was that of Dr. Grossmann of Carnegie-Illinois Steel Corp. in his paper "Hardenability Calculated from Chemical Composition" (Metals Technology, June, 1942, see also THE IRON AGE, April 25, p. 25, and May 2, p. 39, 1940).

Hardenability of most metals, Dr. Grossmann said, can be predicted within 10 to 15 per cent, provided complete chemical composition is known, including "incidental elements," and provided that as-quenched grain size is known and that the composition and heating temperatures for hardening are such as to result in austenite free from carbide particles.

In Grossmann's method of predicting hardenability, the steel is considered as having a base hardenability due to its carbon content alone. This base hardenability is multiplied by a factor for each additional chemical element present.

This hardenability is stated in terms of "ideal critical diameter," or the diameter of a bar in inches which will just harden all the way through in an ideal quench. This calculation for hardenability may also be related to the Jominy test.

The end of the NE era is not yet at hand and industry may well expect further modifications downward in alloy content, especially if the war extends over another year. And this in turn would indicate that a new approach to fundamental metallurgy is badly needed in many metal-using plants which too long have depended upon the steel plant metallurgists for their knowledge. There are exceptions, but these exceptions are few in number.

High Manganese

Of particular interest in the emergency steel picture, and quite aside from the NE types, are the high manganese austenitic steels. These steels, described for the first time last year (THE IRON AGE, Oct. 1, 1942), are said to have mechanical properties similar to the stainless steels, although not quite as corrosion resistant.

Franks, Binder and Brown of the Union Carbide & Carbon Research Laboratories, Inc., who reported on these steels, said they found that when certain amounts of manganese are added to steel of relatively low carbon content, an austenitic steel is obtained which has high strength after cold rolling, both in tension and in compression. Their investigations turned up three types of manganese steels which develop basically the same high strength on cold rolling as the austenitic stainless ordinarily used for structural purposes, but which vary widely in their resistance to corrosion.

The first series consists of 16 per cent manganese, containing a small addition of up to 2 per cent nickel, or up to 1 per cent copper, or both. This type will rust under atmospheric conditions.

The second type consists of similar manganese, nickel and copper content, with about 3 per cent chromium added. This chromium addition is reported to retard progressive rusting greatly under normal atmospheric conditions.

The third type contains 16 per cent manganese and 12 per cent chromium, which is enough to give a high degree of resistance to staining as all the chromium is in solid solution in the austenite.

In the development of these steels it was found that the addition of manganese, alone, to ordinary low-carbon steel was insufficient to produce metal with the desired cold rolling properties. It was found that if manganese was kept between 15 and 18 per cent, with carbon not exceeding 0.35 per cent, the steels could be more readily cold rolled than if the manganese content were lower and the carbon higher. The additions of small amounts of nickel and copper were

TABLE I

Tension and Compression Test Data Obtained on 0.035-in. Thick Strip of Modified Austenitic Manganese Steels

	Chemical Composition, Per Cent								Tension					Compression		
Heat No.	Mn	Cr	Ni	Cu	Si	C	Per Cent Cold Reduction	Condition of Metal	Proportional Limit, 0.01 Per Cent Offset, Lb. Per Sq. In.	Yield Strength, 0.2 Per Cent Offset, Lb. Per Sq. In.	Tensile Strength, Lb. Per Sq. In.	Elongation, Per Cent in 2 In.	Rockwell Hardness	Proportional Limit, 0.01 Per Cent Offset, Lb. Per Sq. In.	Yield Strength, 0.2 Per Cent Offset, Lb. Per Sq. In.	Buckling Stress, Lb. Per Sq. In.
H204	16.49	—	—	1.13	0.22	0.10	—	A	16,000	29,000	120,000	45	90B	16,000	45,000	76,100
							—	A	14,000	31,000	129,100	42		16,000	46,000	80,100
							35	1	58,000	139,000	195,500	18		32,000	109,000	175,200
							35	2	74,000	146,000	187,000	16		84,000	150,000	195,500
							35	1	63,000	131,000	191,800	9	43C	50,000	158,000	206,000
							35	2	95,000	150,000	189,500	12	44C	110,000	184,000	219,500
H641	16.30	—	1.14	1.11	0.27	0.10	—	A	17,000	33,000	132,000	55	85B	15,000	44,000	77,700
							—	A	23,000	34,000	127,700	50		16,000	45,000	78,800
							35	1	34,000	125,000	184,500	17		36,000	110,000	172,500
							35	2	41,000	139,000	181,800	17		73,000	143,000	185,600
							35	1	56,000	125,000	188,000	9	43C	86,000	168,000	202,000
							35	2	75,000	143,000	184,000	14	44C	113,000	190,000	215,500
H604	16.48	3.10	1.83	0.68	0.21	0.23	—	A	28,000	38,000	126,800	71	85B	22,000	50,000	73,200
							—	A	30,000	38,000	127,400	62		22,000	46,000	68,300
							35	1	51,000	135,000	187,800	22		26,000	91,000	160,200
							35	2	50,000	144,000	185,000	18		89,000	135,000	173,000
							35	1	63,000	133,000	190,000	8	42C	54,000	156,000	202,500
							35	2	85,000	146,000	190,800	8	44C	103,000	180,000	216,000
H689	15.62	3.24	1.00	1.08	0.30	0.20	—	A	20,000	31,000	132,600	65	84B	16,000	45,000	74,000
							—	A	26,000	34,000	137,400	74		19,000	47,000	73,700
							35	1	45,000	133,000	190,600	8		27,000	102,000	173,000
							35	2	82,000	146,000	190,500	24		83,000	140,000	182,800
							35	1	61,000	123,000	178,800	5	43C	55,000	157,000	198,000
							35	2	94,000	148,000	200,500	16	44C	96,000	185,000	216,000

A = Annealed by heating for several minutes at 1000 to 1050 deg. C. (1832-1922 deg. F.) and air cooling.
1 = Cold-rolled.
2 = Cold-rolled, heated 24 hr. at 200 deg. C. and air cooled.

to produce a sufficiently stable austenitic steel of high manganese content, so that the metal could be cold rolled sufficiently to give the necessary strength and ductility. Table I shows some of the properties developed in these steels.

The table indicates that after steels are reduced about 35 per cent by cold rolling, they develop a high yield strength in both tension and compression, which is improved when the cold rolled steels are stress relieved by heating 16 to 24 hr. at about 392 deg. F., followed by air cooling. The beneficial effect of low temperature heat treatment on the ductility of the cold rolled steels is especially marked and shows that this treatment will improve fabrication properties substantially.

As these steels appear to be especially suitable for structural applications where high strength and low weight are needed, fabrication characteristics are important. It was found that these steels can be turned, drilled, shaped and sheared without difficulty, provided their carbon content is not too high. Higher carbon content is detrimental to bending and forming, but if the carbon content is controlled, as shown in the table, the steels can be bent through 180 deg. without cracking. Tests also showed that these steels can be successfully spot welded under conditions ordinarily employed for cold rolled stainless steels.

Tests were also made of these steels at subnormal temperatures, having in mind possible aircraft applications. The results showed that none of the steels becomes exceedingly brittle at any temperature down to –85 deg. F., either in the cold rolled or annealed state.

Silicon Monoxide

Some illuminating data were published over the past year on the effect of some of the so-called minor elements, and also on some of the important, but not too well known factors of steel making. Silicon monoxide, for instance, was taken into the limelight for some very interesting probing (THE IRON AGE, Jan. 22 and 29, 1942) by Zapffe and Sims of Battelle.

Their study of this subject brought fourth the belief that [SiO] can exist at steel making temperatures and also may have an important bearing on steel making. Their studies also aroused the suspicion that this factor may be responsible for certain behavior of slag and refractories, not previously satisfactorily explained.

Zapffe and Sims reviewed the rather hazy literature on the subject and themselves conducted a number of investigations and drew the following conclusions.

Silicon monoxide may conceivably be formed in liquid from reduction of SiO_2 or from oxidation of Si. The five principal equations for such reactions are:

I $[SiO_2] + [Fe] \longrightarrow [SiO] + [FeO]$
II $[SiO_2] + (H_2) \longrightarrow [SiO] + (H_2O)$
III $[SiO_2] + [Si] \longrightarrow 2\,[SiO]$
IV $[Si] + [FeO] \longrightarrow [SiO] + [Fe]$
V $[Si] + (H_2O) \longrightarrow [SiO] + (H_2)$

From these studies, the authors reported that increasing temperature and decreasing oxygen pressure favor the formation of [SiO]. It follows, then, that as [FeO] diminishes, the total oxygen content of the steel may actually increase.

With respect to the calculated quantitative relationship of [SiO], the writers expressed the opinion that [Si], in respect to ordinary silicon content, may be predominantly [SiO], while at higher silicon contents, although [SiO] is also at a maximum, the predominating form is [Si].

The five principal equations of reaction noted above were given values for the standard entropy change, the heat of reaction and for the standard free energy changes calculated for 1600 deg. C. (2912 Deg. F.). Of these values, those established for equation I are especially interesting.

These values were: $\triangle$F deg. at 1600 deg. C. (2912 Deg. F.), calories = +22,000; $\triangle$H. calories = +94,500; $\triangle$S deg., calories per deg. = +38.7.

These values were taken to indicate that the total oxygen content of steel should reach a minimum as silicon is added and should then proceed to increase as the silicon content and hence the SiO content increases although [FeO] continues to decrease.

From the values the authors developed a curve based on this relationship, showing how [SiO] may effect total oxygen content.

The authors concede that these studies were largely a matter of preliminary probing and served largely to invigorate thoughts along this line and that the utilization of the theoretical determinations expressed in their report must await more accurate methods of determining the actual concentration of SiO in liquid steel.

The writers also expressed the view that a better knowledge of the subject might well throw new light on some of the still unanswered problems of the chemistry of refractories and slags.

Boron Needling

Much of the work done on the so-called "minor" elements in the past year or so has been inspired by the hope that these elements, some of which are comparatively plentiful, might be profitably used to replace the more scarce alloying materials.

Boron came in for considerable study during the year and several investigators took up the trail where it was dropped some years ago and have come up with some interesting new conceptions of the effect of boron, particularly with respect to the quantity which must be added to obtain desired results.

The suggestion that small additions of boron probably would increase tensile strength, without noticeably changing the reduction of area or percentage of elongation, was made by N. F. Tisdale (*Metal Progress*, March, 1942). Tisdale also reported the use of boron to increase hardness penetration (better known as hardenability).

In cast iron, 0.02 to 0.10 per cent boron is used effectively with beneficial results, since large amounts of Fe_3C are present to hold the iron boride in solid solution. This element inhibits graphitization, thus tending to give white fractures in which carbon is present in the combined form.

Boron also acts as an agent for the control of depth of chill in iron rolls and also increases surface hardness. New developments in the method of adding boron to iron and steel are responsible in a large measure for the commercial success of this element. A recently developed ferro-boron, containing 10 to 14 per cent boron, has resulted in higher efficiency and greater recovery than formerly.

This low melting point ferro-boron acts as a ferrite strengthener and as an agent in the formation of complex carbides. Research is now underway on the use of boron in plain carbon as well as alloy steels. Since a few thousandths of one per cent of boron will produce very marked changes in

physical properties, close control of the additions is a vital procedure.

Some interesting remarks on boron were contained in Dr. M. A. Grossmann's paper entitled "Hardenability Calculated from Chemical Composition." (*Metals Technology*, June, 1942) Dr. Grossmann remarks that boron is a powerful element for increasing hardenability, having its maximum effect when added in the extremely minute amount of 0.0025 per cent. A handicap in boron use, he points out, is that analytical methods for such small amounts are rather unsatisfactory at present.

T. W. Lippert brings out the fact (THE IRON AGE, Nov. 19, 1942) that actually there have been several boron-containing additions available for a number of years. He stresses that one of the problems faced in making effective use of boron is that of obtaining good distribution of the addition throughout the ladle. This achievement is complicated by the fact that such additions are usually very small and some aid from other elements is necessary to obtain this distribution and to protect the boron from oxidation. The makeup of one of these commercial additions is about as follows: 5 per cent boron; 10 per cent titanium; 35 to 40 per cent silicon; 6 per cent manganese; 6 per cent zirconium, and 10 per cent vanadium.

Lippert points out that boron is quite similar, and can be used to obtain the same general end effects as maganese, chromium, nickel, molybdenum, vanadium and silicon. It differs from these alloying elements only in that very minute percentages of boron are necessary to obtain the desired effect and any additions in excess may easily lead to hot short troubles.

As little as 0.0006 per cent boron has been reported as giving definitely favorable results on hardenability. The amount giving optimum effect is around 0.001 to 0.003 per cent, while as little as 0.01 per cent may lead to trouble.

Data on the exact amount of boron which will replace a more conventional alloy to achieve a desired effect are difficult to obtain, due chiefly to the lack of dependable methods for determining the very small amounts of boron present in a steel.

However, comparisons between the amounts of boron added and the other elements present as determined by analysis are quite readily made. If the various alloys are added to a plain carbon steel containing 0.75 per cent manganese and 0.25 per cent silicon, then the addition of 0.002 per cent boron (added in the form of an alloy containing 0.50 per cent boron, 10 per cent titanium, 35 to 40 per cent silicon and small quantities of aluminum, calcium and zirconium) has the same effect on hardenability as 0.75 per cent manganese, 0.35 per cent chromium, 0.25 per cent molybdenum, 1.5 per cent nickel or 1.5 per cent silicon.

Lippert warns that boron is no cure-all for the difficulties of a steel producer, but should be an important factor in overcoming the shortages in other critical alloying elements. Boron may well exert secondary influence not yet encountered, but thus far no unfavorable ones have appeared.

Columbium and Titanium

Results of an investigation of the effects of columbium and titanium in chromium and molybdenum steel have been reported by C. L. Clark (*Oil & Gas Journal*, April 2 and 23, 1942). Additions of columbium or titanium, added to a steel of 5 per cent Cr-Mo type were found to reduce hardening after both air cooling and welding. Both elements are carbide formers and the solubility of the carbides is low at heat treating temperatures. The carbon is thus rendered inactive, and for temperatures up to 1800 deg. F., the effect is to decrease carbon content to less than 0.05 per cent.

To reduce hardness of pressure resistance welds and spot welds in 25 Cr-12 Ni steel to below 200 Brinell, heat treatment is needed, but if the proper amount of columbium or titanium is present, the stabilized steel can be air cooled from 1500 to 1750 deg. F., instead of at the slow cooling rate of not faster than 50 deg. F. per hr., which would otherwise be necessary.

On tests for high temperature strength, the values for rupture strength of a steel of 5 per cent Cr, Mo, plus titanium, are lower than for 5 per cent Cr, Mo at temperatures ranging from 900 to 1500 deg. F. After both annealing and tempering, the columbium-containing steel is superior to 5 Cr, Mo at 1200 and 1000 deg. F. Heat treatment, it was concluded, does have an influence on the rupture strength of the columbium modification, but does not on the titanium type. Heat treatment has no effect on the creep strength of 5 Cr, Mo plus titanium. The addition of titanium reduces strength at 1200 deg. F., but is without influence at 1000 deg. F. Columbium additions, however, improve creep strength, with the degree of improvement being more pronounced after tempering treatment than after annealing.

Further light on columbium, especially with respect to its effect on temper brittleness of special steels, was shed by S. T. Kishkin (*U.S.S.R. Bulletin of Academic Science*). In this report, columbium

TABLE II

Effect of Tin on Structural Steel, 1/2-inch Plate

Ingot No.	Position	Tin, Per Cent	Direction *	Hot-rolled					Annealed 1650 deg. F., Furnace-cooled				
				Yield Strength, Lb. per Sq. In.	Tensile Strength, Lb. per Sq. In.	Elongation in 8 In., Per Cent	Reduction of Area, Per Cent	Charpy Impact, Ft-lb.	Yield Strength, Lb. per Sq.-In.	Tensile Strength, Lb. per Sq. In.	Elongation in 8 In., Per Cent	Reduction of Area, Per Cent	Charpy Impact, Ft-Lb.
2	Top	0.028	L	35,050	60,900	31.2	52.1		29,070	51,920	30.4	58.9	
			T	36,030	60,160	25.0	41.8		27,560	51,610	30.4	55.7	
	Middle	0.030	L	38,010	62,220	25.7	55.0	31.8	29,400	53,610	27.3	53.7	14.5
			T	33,640	62,120	25.7	46.5	18.5	25,020	53,600	28.9	46.4	6.5
	Bottom	0.026	L	33,720	59,900	27.3	52.4		25,830	52,960	28.1	53.7	
			T	35,660	59,390	27.3	47.1		24,940	52,900	29.6	45.8	
3	Top	0.091	L	36,760	60,840	24.2	48.8		30,140	52,180	29.6	60.1	
			T	37,250	60,420	23.4	40.8		27,200	52,080	27.3	55.7	
	Middle	0.103	L	37,640	65,320	24.3	47.7	27.2	32,380	56,360	26.5	49.8	10.0
			T	37,270	65,200	24.3	39.1	18.2	28,810	55,990	25.0	43.0	5.0
	Bottom	0.111	L	34,100	61,620	26.5	54.4		30,700	54,070	30.4	57.4	
			T	34,500	62,200	25.7	47.1		29,030	53,770	26.5	52.0	
4	Top	0.196	L	36,320	63,580	25.0	52.0		29,840	54,910	28.1	57.9	
			T	37,890	63,660	25.0	44.6		30,490	55,760	29.6	37.0	
	Middle	0.229	L	39,250	65,640	23.4	35.2	26.0	31,170	58,650	24.2	49.3	4.2
			T	40,390	66,130	20.1	24.2	17.8	30,450	58,700	26.5	47.7	4.0
	Bottom	0.227	L	39,910	64,150	25.0	45.9		32,270	55,770	27.3	54.9	
			T	38,100	63,540	25.0	48.9		28,420	55,900	26.5	51.6	
5	Middle	0.337	L	41,120	69,200	24.2	40.1	22.2	34,080	60,920	26.5	52.0	2.5
			T	42,280	68,770	21.0	24.7	14.8	32,360	60,550	25.0	40.9	2.8
	Bottom	0.313	L	39,500	65,870	25.0	50.3		34,810	57,820	25.7	50.7	
			T	39,370	66,250	19.5	42.3		34,720	57,420	26.5	48.0	

* L stands for longitudinal; T, transverse.

was described as being somewhat similar to molybdenum in that it decreases the temper brittleness of special steels.

The carbides of columbium and molybdenum are dissolved back into the solid solution only at very high temperatures, of the order of 2200 to 2375 deg. F. When hardening steel from normal temperatures, the carbides of columbium and molybdenum exist in the metal in that form in which they were present before hardening, that is, as relatively coarse particles.

These carbide particles serve as centers of crystallization of the coarse carbide masses during the tempering process and prevent appearance of the new fine carbides which cause temper brittleness.

The effect of manganese in processes causing temper brittleness is connected not with its presence in the solid solution of α-Fe, but with the property of forming slightly soluble carbides.

Hardening from 2375 deg. F. and tempering at 390 to 490 deg. F. for two hours does not increase the impact resistance, or increases it very little, as compared with hardening from normal temperatures with the same tempering.

The slight decrease of impact resistance observed in some cases, after hardening from 2375 deg. F. and low tempering, is smaller as the columbium content of the steel is increased.

Nickel steel containing no special carbide forming elements has no tendency toward temper brittleness when hardened from either 1690 or 2280 deg. F. Nickel and silicon-nickel steels containing molybdenum or columbium are insensitive to temper brittleness only when hardened from comparatively low temperatures at which the carbides of molybdeum and columbium cannot dissolve in the solid solution of γ-Fe.

Nickel and silicon-nickel steel containing molybdenum or columbium possesses temper brittleness if the hardening temperature is sufficiently high for the carbides of molybdenum or columbium to dissolve in the solid solution.

Nitrogen

Investigations into the effect of both nitrogen and hydrogen, accelerated over the past few years, are continually shedding new light on the importance of these too-little known elements. One of the chief obstacles in research on these two elements is that they are usually present only in extremely small amounts, and the difficulty of accurately measuring this quantity with reproducible certainty tends to hamper such research.

One of the late reports on nitrogen is that of Uhlig (ASM preprint No. 23, Oct., 1942) on the effect of this element in 18-8 stainless steels. He points out that very pure nitrogen-free 18-8 alloy, quenched from 2100 deg. F., is actually ferritic, not austenitic at room temperature.

Nitrogen, which is accidentally present in the commercial 18-8 alloy, is found to inhibit the gamma-to-alpha phase change occurring on cooling to about 210 deg. F.

Alloys were prepared in pure alumina crucibles from nitrogen-free iron, chromium and nickel, melted in a vacuum. The resulting ferritic 18-8 analyzed 0.165 and 0.24 per cent N_2. The nitrogen content, with carbon at 0.007 per cent, proved, within the limits of X-ray identification, to be sufficient to insure pure austenite phase.

The yield strength of ferritic 18-8 was found to be 2.5 times that of austenitic 18-8 and the Brinell hardness 1.7 times greater. The conductivities, both electrical and thermal, of the ferritic material, are less, being about 70 per cent that of the austenitic alloy. The coefficient of expansion below 930 deg. F. is about 60 per cent that of the austenitic type.

Tensile strengths in the two types are comparable, a not unexpected point, because austenite on deformation is converted to ferrite. The corrosion resistance of the two structures is about the same for the long time heat treated and water quench alloys.

Hydrogen Convicted

Hydrogen has long intrigued steel metallurgists and it has been suspected of many crimes, but few of these sins have actually been directly connected with it. One reason for this is the lack of adequate instruments for accurately measuring the extremely small amounts of hydrogen commonly found in steel.

R. J. Cowan of Surface Combustion Corp. made an interesting contribution (THE IRON AGE, Nov. 12 and 19, 1942) to this subject in the past year in a study relating hydrogen content of steel to the moisture in the blast air in cupolas and blast furnaces.

Cowan made the interesting point that hydrogen content should be considered on the basis of its volume, rather than as a weight percentage. In this manner a clearer picture (see Fig. 1) can be obtained of the why of its influence. He indicated that, for example, in a steel analyzing 0.0004 per cent hydrogen actually about one-third the volume of the metal is hydrogen. Or 0.005 per cent hydrogen by weight is the equivalent of 2 cu. ft. of hydrogen in 1 cu. ft. of iron.

Several cast iron specimens, produced with varying known moisture content of the blast, were analyzed for hydrogen with the following result: The specimen produced with 1.49 grains of moisture in the blast had 0.00004 per cent hydrogen; 10.4 grains equaled 0.00009 per cent H; and 21.3 grains equaled 0.00018 per cent H.

As among the effects of hydrogen, Cowan listed the following:

It increases the number of cracked castings and prolongs the annealing time for malleable iron; it retards graphitization and increases the depth of chill in cast iron; it imparts properties to pig iron that persist through successive melting operations and causes flaking in steel; it causes brittleness, low elongation and small reduction of area of standard specimens.

Discussing the cracking of metal sections caused by excessive hydrogen content, Cowan said it appeared to take place along the following lines. Atomic hydrogen has the power of penetrating metals. If this comes out of solution in the interior of the metal at a small cavity or blow hole, or non-metallic inclusion, the atoms combine to form molecular hydrogen, H_2, which is insoluble in steel and cannot diffuse out.

An experiment is recorded in which a steel bar was bored to provide a hollow cylinder that could be fitted with a pressure gage. Hydrogen was evolved from the outer surface of the tube by electrolysis and after a short time the pressure rose on the inside to 4300 lb. per sq. in., the limit of the gage.

All the hydrogen does not come out of solution in this way, so that a double effect is to be noted—that which accounts for cracking and that which remains in solution and causes embrittlement.

Cowan makes the point that moisture control of the blast is essential not only for effecting efficient combustion and thus lowering fuel cost,

• • • On its way for a rendezvous with destiny off Tokyo. Ships are the tendons of global war, and those tendons will soon be strong enough to flex with authority.

but also for the purpose of controlling the hydrogen content of the metal. This latter consideration brings up the fact that additions of coke to the charge, in say a cupola, to counteract the influence of blast air heavily laden with moisture, may balance the combustion equations, but does not necessarily reduce the hydrogen content of the blast at the point where it is in a most favorable condition to unite with the molten metal — at the tuyeres.

It appears to be more desirable to remove the moisture by some external system, such as the commercial air conditioning units available, and thus obtain the double benefit of better combustion and at the same time low hydrogen content of the blast *before* the air enters the cupola or blast furnace.

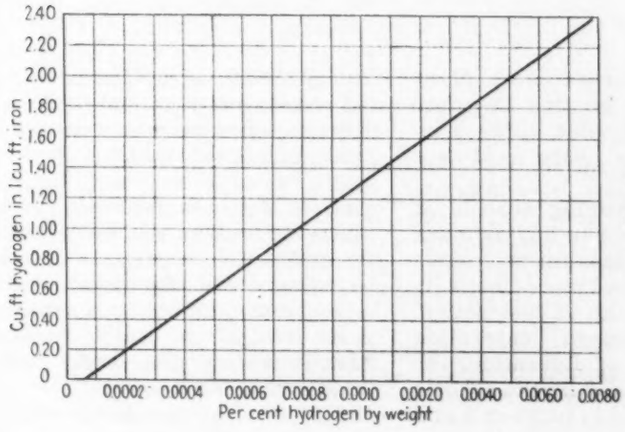


FIG. 1—Hydrogen content by weight related to content by volume, in steel.

Reclamation Headaches

Substitutes can, and often do, give rise to technological headaches almost as severe as the shortage of the original material itself. This was particularly true with the development of a copper clad steel for bullet jackets, to replace the solid gilding metal originally used for this purpose.

As a unit, this clad metal substitute runs 80 per cent mild steel and 20 per cent copper and zinc. When peak production of this clad metal is reached some 11,000 tons of scrap will result each month. In view of the scrap shortage, it is imperative that some means be devised of utilizing this tonnage. Yet, the amount of copper and zinc on the steel renders it unusable in the open hearth.

A study of methods of separating the copper and zinc from the mild steel backing was undertaken by A. J. Thompson of the National Academy of Sciences. After investigating a number of proposals, he reported (THE IRON AGE, Nov. 12, 1942) that the only fully developed and practical process available for this purpose is the cupric ammonium carbonate process.

This process is based on the solvent action of cupric ammonium carbonate on copper and zinc. It is a cheap and efficient method and will permit almost complete recovery of the copper and iron as separate products—the copper as an oxide and the iron as unattacked scrap. The recovery of zinc is an unknown factor, and is expected to be quite poor, unless an additional leaching treatment is performed on the copper precipitate before smelting.

The cost of operating such a recovery plant was put at $5.21 per ton of scrap, while the overall charge against the copper would be about 2.5c. per lb. The recovered steel scrap, if bundled, could probably be sold as No. 2 bundles.

It was pointed out that there are several other possible means of separating the steel from the non-ferrous materials, including electrolytic methods, but the cupric ammonium carbonate process appears to be the most promising.

Another scrap problem that received much overdue attention in the past year was that of the effect on steel of the tin content of scrap. With mills grabbing everything that looks like metal, including tin cans, for open hearth fodder, the study by J. W. Halley of Inland Steel Co. (AIME paper read at the National Metal Congress; reported in THE IRON AGE, Oct. 22, 1942) added a good bit of data to what is already known on the subject.

Halley pointed out that since a tin can contains 1.5 per cent tin, it is quite possible to have up to 0.75 per cent tin in steel made with a 50 per cent scrap charge. The undesirability of tin in steel, he pointed out, depends partly upon the use to which it is to be put.

The influence of various amounts of tin in low carbon rimmed, semi-killed structural, medium carbon forging and rail steels was reported in Halley's paper. Top and bottom slats from a comparison ingot were rolled to 0.093 gage bands on a hot strip mill. No evidence of checking was found in any of the ingots rolled. Edge and center analyses made to determine the extent of tin segregation, showed that tin segregates in a manner similar to sulphur, but not to as great a degree. It was indicated that the effect of one per cent tin is to increase Rockwell B hardness 0.6 points, and tensile strength is boosted 300 lb. per sq. in. When these same test bands were cold reduced to 0.040 in. and box annealed, the hardening effect was not so marked.

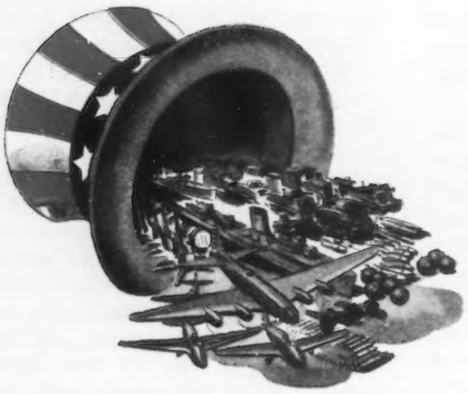
The effect of tin on semi-killed steel, with additions of from 0.1 to 0.3 per cent tin to various ingots, was studied by rolling on a universal plate mill. No serious rolling difficulties were experienced, but the two ingots with the greatest amount of tin showed checking at the blooming mill. The results of this test are shown in Table II.

The uniform decreases in ductility and impact resistance found in the lower carbon steels were not shown by the forging quality type. There was a marked drop in these two values, between 0.104 and 0.227 per cent tin, while the increase in tensile and yield strength caused by tin appeared to be somewhat greater in the lower carbon steels. Jominy end-quench tests showed no difference in the hardenability in the forging steels.

Standard drop tests on rail steel, to which varying amounts of tin were added, showed that the number of blows to failure increased as tin decreased, while stiffness, as indicated by elongation, was also increased. The tin also caused a moderate increase in Brinell hardness which was not uniform, there being a sharp increase when the tin content reached 0.05 per cent. Yield strength and tensile were increased more by tin in rail steel than in the low carbon types.

It was pointed out that the lack

(CONTINUED ON PAGE 214)



WELDING—

By FRANK J. OLIVER
Technical Editor, THE IRON AGE

PERHAPS the best indication of the tremendous impetus given to welding in the war effort is the fact that for the past year and for many months to come, the capacity to produce electrodes has been and will continue to be out of balance with steel fabrication requirements. Stabilization is expected by March 1 or shortly thereafter. In the meantime, shortages will continue until the new capacity to produce electrodes comes into the picture and some present production difficulties are ironed out.

The distribution of welding rods and electrodes was first put under strict control by limitation order L-146 issued June 1, 1942, and later revoked on Dec. 9. They could be delivered without restrictions only to the Army and Navy, specified government agencies and governments of the United Nations for operations under the Lend-Lease program. Deliveries of ordinary rods to others were confined to orders bearing a preference rating of A-9 or higher. Delivery of alloy rod could not be made except on orders bearing a rating of A-1-j or higher. The order also provided for the setting aside each month for repair and maintenance purposes only 6 per cent of the total amount of rod delivered to any user the previous month.

The situation in electrodes was so tight by midsummer, however, that except for repair work and essential civilian producers, welding rod and electrodes became available only for war work. Many producers were quoting 12-month deliveries and by Dec. 1, the principal producers were sold out through 1943.

Accredited training schools at first were allowed to buy as much rod as they needed, but no trainee could be furnished more than 1 lb. of electrode per hr. of instruction. Since then, through cooperation with the Office of Education, the consumption of rod by the schools has been reduced to between 5 and 6 per cent of total rod production and about half of this is bare or wash coated electrodes.

Order L-146 also limited inventories to a maximum of a 60-day supply. Since then, there has been a check-up every 15 days on inventories. Manufacturers have had to file a record of shipments each month by class of user (government and industry) and by type of electrode. End use of each type of rod received each month must be reported by customers.

The situation in welding rods has been much the same as in the general steel picture. There has been much disagreement and argument as to whether any real shortages existed in the first place, whether the capacity to make electrodes was sufficient, whether enough steel wire was being allocated for this purpose, or whether it was just a case of maldistribution and unbalanced inventories. Some think that if the WPB had allowed the industry to solve its own problems, all vital customers would have been amply taken care of. One story is that the issuance of directives last summer allocating large blocks of rods to a few critical consumers is what upset the whole market. It was a case of robbing Peter to pay Paul. Then Peter hollered and so Joe was robbed. Joe let out a cry that he was being handicapped, so he sought aid. Finally, everybody ended up by being short—all except Paul who sat behind a six months' inventory. At least, that is the way one leader in the industry summed it up.

Not all electrode manufacturers agree with this version. Some directives did undoubtedly divert badly needed material to building up some shipyard inventories, and when the situation was most chaotic, there was what seemed to be a flood of directives, but on a percentage basis they accounted for less than 10 per cent of the industry's output in any one month. In recent months, the number of directives issued has been small. It is generally agreed now, however, that the situation has been thoroughly analyzed by the WPB and balancing of production and consumption is in sight. A separate Welding and Plating Branch has been set up within the General Industrial Equipment Division of the WPB, indicating that official recognition has been taken of the vital importance of this industry and its supply problems. Up to seven months ago, the welding industry was practically a step-child in Washington.

At one time it was a lack of steel that was hampering the electrode industry. This was largely a question of the right kind of priorities. This phase of the situation was

Given Tremendous Impetus by War

. . . Shortages of supply of arc welding electrodes last year overshadowed technical developments in this field, which have been many. Early confusion has been eliminated, however, and steps taken months ago should achieve balanced rod production and consumption by March 1 unless requirements are unexpectedly altered.

° ° °

cleared up through cooperation of the Steel Branch of WPB. Since September there has been no complaint as to wire shortages on the part of the electrode manufacturers. In fact, within the last quarter, all manufacturers were asked to step up their output of bare or lightly coated rods in order to relieve the pressure on heavy coated rods. In November the WPB let it be known that there was no holdup or bottleneck in the production of dust coated or sul (rust) and lime coated wire. A large part of this production will go into maintenance welding and will take care of at least half of the requirements of training schools. About 15 years ago, practically all maintenance and repair were done with bare electrodes and except for highly stressed parts is entirely satisfactory in many cases. Bare rod is also well suited for tack welding as it leaves practically no slag to be removed prior to final full fillet welding.

Last June when the electrode situation became critical and the government started a study of the situation in an attempt to project the total requirements for welding rods, it was recognized that there was a close relationship between rod consumption and plate consumption. Whereas arc welding has been applied to pipe, tubing, structural steel, etc., the big consuming industries today use welding in plate fabrication. In the last year, these have been cargo ships, naval vessels, landing barges, gun mounts, combat tanks and machinery. Welding has largely replaced riveting in shipbuilding to save steel and speed up fabrication by reducing the manhours required to put the plates together. Eliminating overlaps, butt straps and the rivets themselves results in a reduction of close to 10 per cent in the amount of steel going into a cargo ship.

Another factor is that the new WPB national emergency specifications for design, fabrication and erection of structural steel for buildings requires the designer to certify that "the building has been designed to secure the greatest savings in steel practical through continuity in design and welded fabrication." Shipbuilding alone is taking 60 to 70 per cent of all arc welding electrodes. The fact that the scheduled output of all these items was stepped up tremendously meant a corresponding rise in plate production. This is borne out by the fact that plate production rose 93 per cent in 1942 over 1941. Steel of all categories that went into shipbuilding in 1942 was 3½ times the quantity that went into boats in 1941 and over 10 times the 1940 figures.

More Welding on Narrow Plates

To meet this tremendous increase in demand for ship plates necessitated conversion of continuous strip mills for this work. Such plates are narrower than plate rolled on big plate mills and this means more seams and hence more weld footage in each boat. All these factors had to be taken into account in projecting electrode requirements. Eventually, rod consumption was related statistically to each ton of plate in each general type of product. About 55 lb. of rod per ton of plate, for instance, is consumed in fabricating a 10,500-ton Liberty ship. A lesser ratio prevails for naval vessels. Once these ratios were established and plate requirements determined, it was a relatively simple matter to set the sights for electrode requirements. The only indefinite factor now is possible shifts in plate consumption. That is why the projected monthly output of rods ranges all the way from 90 to 120,000,000 lb. Total output in October was a little over 70,000,000 lb., but it is expected that by March 1, the rising electrode production curve will cross the relatively flat requirements curve.

Practically every electrode manufacturer has increased his output considerably in the past year and by several hundred per cent compared with two years ago. Many new coating lines have been installed and three new plants are now under construction. Metal & Thermit Corp., Hollup Corp. and Arcrods Corp. are putting up new plants. For a while it looked as if the incredible Henry Kaiser would become an electrode manufacturer, too, but WPB called this off after first fostering the idea. The anonymous Arcrods Corp., which is jointly owned by General Electric and Air Reduction, put its new West Coast plant into production a few weeks ago. It will feed the shipbuilding industry there.

Shift of many electrode producers of a part of their capacity to stainless (302 modified) rod for armor plate welding more than proportionately reduced carbon wire electrode capacity inasmuch as these heavy mineral coated rods can be produced at only one-fifth the speed of mild steel rods. Much heavier extrusion pressures are required and the drying is slower and trickier. Present expansion

programs of stainless electrode specialists will permit others to concentrate on carbon rods. At least one manufacturer is dipping stainless coated rods successfully. This relieves the demand on extrusion coating presses.

Present extrusion press capacity is being stepped up by faster speeds. Priority ratings as high as AAA have enabled press manufacturers to give such orders the promptest attention. As a result, there is no complaint as regards press deliveries. Rods are shot out of such presses like machine gun bullets. The average production rate is 400-500 rods a minute but some producers are going up to 700 or 800 a minute on the smaller size rod, and at the same time reducing scrap considerably. Rejects have run as high as 25 per cent. Concentricity and uniformity of coating is a governing factor, plus drying control. If the coating dries too rapidly on the outside, internal moisture explodes the coating and leaves holes. Cracking of the coat is another drying difficulty. Licking these production problems will go far toward stepping up potential capacity.

Electrode coatings that are concentric but are rejects because of blow holes, gas pockets and cracks of short length can readily be used by the welding schools for practice where the ultimate in quality is not required. The WPB has recognized the necessity of taking care of the schools and has allotted them about 3,000,000 lb. of electrodes a month for training purposes, of which about half is in the coated rods, the other half being in the wash coat variety. Frequently electrode material with coating defects is stripped and is then given a wash coat.

It is obvious that letting the training schools have the rejects is only a temporary stopgap. The main attack is being made on improving quality and reducing rejects. One producer has adopted the latest statistical methods of quality control to isolate the variables and increase the percentage of OK material processed.

Coating Standardization

One of the largest producers believes that if the efficiency of production of the whole industry could be brought up to the level of the most efficient (meaning his plant), there would be sufficient capacity to take care of present and future needs without added facilities. Certainly this side of the picture has not been overlooked. The present emergency, for example, is causing electrode manufacturers to get together and exchange technical information for the first time in an industry that has been characteristically highly secretive. This about-face is also partly accounted for by the trend toward electrode standardization as regards specifications of the physical properties desired in the as-welded metal, because in order to achieve these physicals there has been considerable narrowing of the variations in coating formulation, despite the large number of materials available (see Table I).

Added to this technological trend toward standardization of coatings is direct government pressure in this direction. A few weeks ago the various manufacturers and representatives of principal users were called together and asked to select three or four coating formulations that could be used by all. It is understood that all but one manufacturer has agreed to such a move. He has a formulation on one big production item that has been highly successful and apparently wants to retain this "edge" on competition.

In general, most suppliers agree that the differences in coatings of many standard rods is no more than between twee-diddle-dum and twee-diddle-dee. Even in stainless electrodes, which have not as yet been even tentatively standardized, the mixes in the two different types of coating used have been narrowed in the same way. Today these differences are not so much in the chemistry of the mineral or cellulostic coatings, as in the base source, the several forms in which calcium carbonate exists in nature, for example, and even in specific deposits. Cellulose also exists in many natural forms, and the source is not always evident from a chemical analysis.

Another deviation is in the particle size of the variety of minerals used. In fact, it is the variation in particle size specifications of the various rod manufacturers that is causing a partial bottleneck in the mineral supply industry. Special crushing rolls are used for preparing the minerals in powder form for use in the coating mixers. This equipment requires almost a day to clean up in changing from one particle size to another, even of the same mineral, such as ferromanganese. The low carbon variety is particularly difficult to crush, being less friable than the higher carbon grades. As information among manufacturers is exchanged, however, there is bound to be closer agreement as to particle size and this will permit longer runs and hence more efficient utilization of mineral crushing machinery, since changeover time is the critical factor.

Most manufacturers agree that this standardization of rods is a good thing. Although tentative standards on iron and steel arc welding electrodes were first issued in 1940, it was not until the last year that the AWS-ASTM standard designations came to be widely used in discussing welding procedure and in buying rods. Now they are becoming as much a part of the technical language as were the SAE steels and now the NE steels are. Trade names still pre-

TABLE I

Standard Minerals and Fluxes Used for Welding Electrodes

MINERALS
- Rutile (natural titanium dioxide)
- Pure titanium dioxide
- Titanium zirconium ferrate
- Ilmenite (iron titanate)
- Ferrotitanium
- Manganese dioxide
- Manganese oxide
- Natural manganese carbonate
- Chromite (chromic and ferric oxide)
- Magnetite
- Nicaceous hematite
- Iron powder
- Magnesium silicate
- Aluminum oxide, fused
- Clay (air floated)
- Bentanite (collodial clay)
- Zirconium silicate

FLUXES
- Calcium fluoride
- Calcium carbonate
- Calcium metasilicate (wollastonite)
- Strontium carbonate
- Powdered glass
- Lithium fluoride
- Lithium chloride
- Rare earth oxide (cerium oxide 50 per cent)

FERRO-ALLOYS
- Ferromanganese (7 and 1 per cent C)
- Ferromolybdenum
- Ferrosilicon
- Ferrotitanium (low carbon)
- Ferrochrome

ORGANIC FILLER
- Alpha Cellulose
- Wood flour
- Borcote cellulose

ABOVE

WAR needs have greatly increased the application of arc welding. This picture taken in the Firestone Tire & Rubber Co. plant shows a vast array of welded carriages for the Bofors 40-mm. anti-aircraft gun.

Photo James F. Lincoln Arc Welding Foundation.

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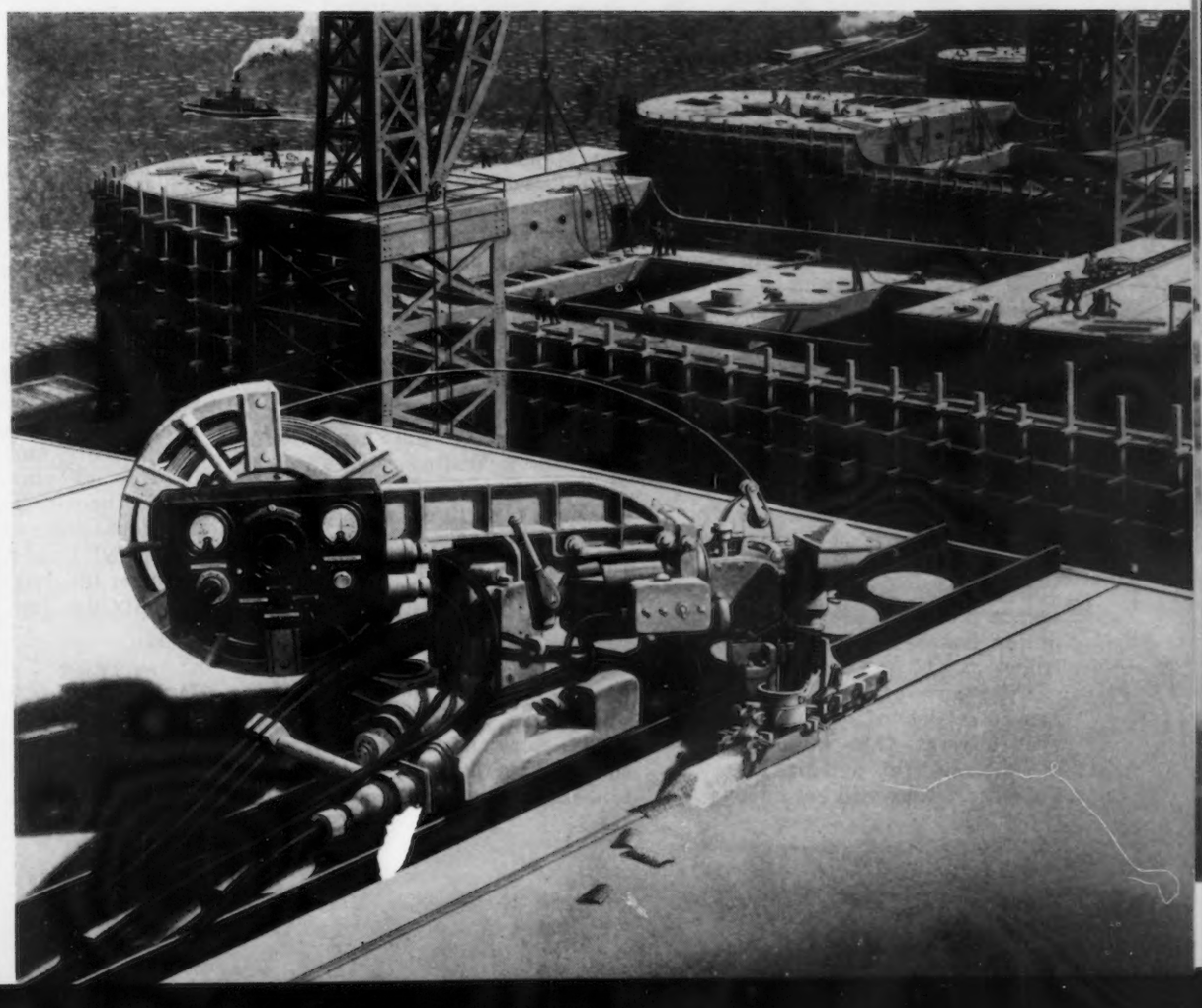
RIGHT

PART of the credit for increased speed in assembling ships can be given to the widespread use of the automatic submerged melt process for straight-away welds on deck plates and other flat positioned and fillet work.

Photo Linde Air Products Co.



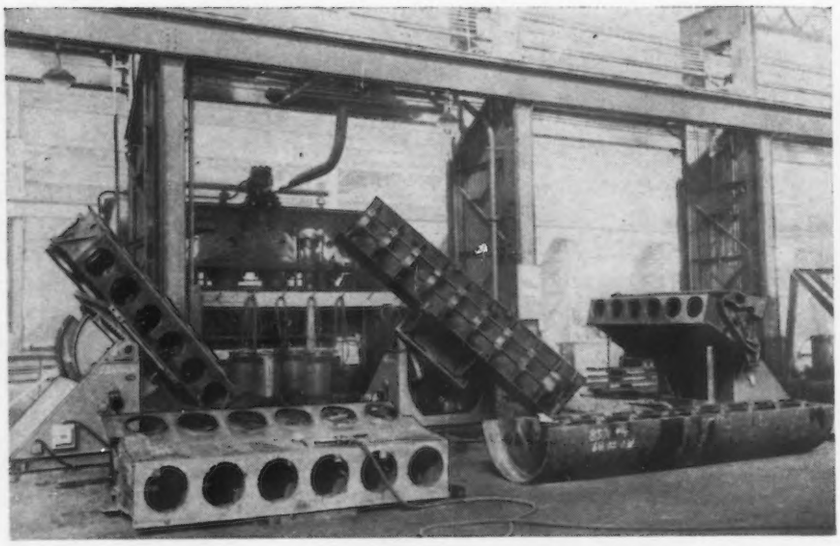


Photo Ransome Concrete Machinery Co.

WELDING positioners are being used wherever possible to obtain the advantages of faster downhand welding with larger electrodes. This view shows three 8-ton units handling diesel engine crankcases and other heavy products in an Eastern locomotive plant.

vail, of course, but electrode manufacturers are now putting on their labels the AWS classification number corresponding to the brand name or number.

AWS Standards

Tentative specifications for iron and steel arc welding electrodes (serial designation A 233-42T) were accepted by the American Welding Society and the American Society for Testing Materials in the spring of 1942. These specifications represent a revision of those originally issued in 1940 and include 30 different types of electrodes covering practically all classes of work. (See "How to Select Arc Welding Electrodes," Oct. 15, 1942 issue of THE IRON AGE).

A new tentative specification A251-42T for iron and steel gas welding rods was also accepted last year by both societies. It covers six types of rods for both stress relieved and non-stress relieved specimens. Another new tentative specification approved by the AWS is one covering aluminum and aluminum alloy metal arc welding electrodes. Two types have been approved so far, one having 4.5 to 6.0 per cent silicon and the other less than 1 per cent silicon plus iron. No serial designation has been given these electrodes as yet.

Shortages of electrodes have caused a lot of people to look wishfully at this industry and make a stab at getting into the business. They will get no help as to coating formulation from the tentative specifications mentioned above and will probably have difficulty in getting priorities on machinery. There are several who stand ready to help them, however. Some users, lacking priorities high enough to top the present supply, have resorted to desperate measures such as taking a copper coated bessemer gas rod and improvising a dip flux to use it as an arc welding electrode.

A.C. All-Position Electrode

One of the newest electrodes which is rapidly coming to the fore because of the widespread use of a.c. arc welding on heavy steel structures is AWS class E6011, an all-position heavy coated electrode primarily developed for use on a.c. The nature of the electrode coating is such that somewhat higher welding currents can be used and the melting rate is higher than in the case of the class E6010 electrodes which are primarily designed for d.c. welding. This new E6011 electrode is finding wide applications in pressure vessels, ships, pressure pipe lines, storage tanks and machinery of all kinds, although about 80 per cent of the hand welding rods used in shipbuilding is still the class E6010 reverse polarity d.c. type.

In fact the use of a.c. arc welding received considerable impetus during the past year because of two factors primarily. One was the introduction and rapid acceptance by government agencies, the armed services and industrial concerns of the class E6011 electrode. The other was the extremely tight situation in d.c. motors and generators. One reason for the tightness in d.c. motors is the fact that the Navy is requisitioning large numbers to be used for hoists, winches, elevators, bulkhead doors and gun turrets because of the high starting torque and braking characteristics of d.c. motors. The other reason is that the capacity for their manufacture has been reduced and at the same time there has developed a scarcity of copper, steel and other vital metals. Manufacturers who supply both d.c. and a.c. equipment are quoting up to 30 weeks delivery on d.c. equipment and are urging buyers to accept a.c. equipment where they can. Welding transformers use less copper and steel than M-G sets and take less man-hours to produce.

Up until the development of this all-position a.c. rod, the use of a.c. equipment was largely limited to positioned work. This limitation was not as rigid as appears at first glance, however, inasmuch as there has been a steady increase and concurrent development in welding positioners. There are a number now in use that will swing work 20 ft. in diameter and over. More will be said about positioning later. In welding extremely heavy structures, where positioners of the proper size or capacity were lacking, the absence of a suitable electrode that could be used overhead or on vertical welds had actually resulted in installations combining d.c. equipment for overhead work and a.c. for horizontal fillets and flat welds. The class E6011 electrode does away with the necessity for this dual arrangement where a.c. welding would normally be the first choice for heavy plate work.

Although the physical property specifications for the deposited metal are the same for both the class E6010 and E6011 rods, according to published results of tests, the physical properties of the deposited weld metal from the class E6011 rod are slightly better than for the corresponding reverse polarity d.c. rod, as indicated below:

AWS Class	E6010	E6011
Tensile strength, lb. per sq. in.	67,000	72,500
Yield point, lb. per sq. in.	55,000	60,000
Elongation, per cent	25	27
Charpy impact, ft.-lb.	30	34

There was an all-position a.c. electrode available before, the class E6013, but this, like the corresponding E6012 d.c. rod, was what is known as a "poor fit-up" electrode, because of its ability to bridge wide gaps in joints. For this very reason, however, it lacked penetration, and with more attention being paid to fit-up and the use of deeper penetrating rods, some other all-position a.c. rod was needed. The arc action of the class E6011 rod is forceful and digging, just like the E6010 d.c. rod. Both are heavily coated and rely on the presence of cellulose in the coating to produce a protective atmosphere (carbon dioxide and water vapor) about the arc, and titanium dioxide and either magnesium of aluminum silicates as slag forming constituents of the coatings.

Due to the short time the class E6011 rod has been available, the amount of experience obtained with it has been limited, but it appears well suited to the welding of many types of high tensile low alloy steels due to the combination of high yield point and ultimate strength with high elongation. The nature of the coating is such that somewhat higher welding currents can be used and the melting rate is slightly higher than in the case of the E6010 electrode. Hence, although designed for all-position work, it is more economical to use on flat welds and horizontal fillet welds when a.c. equipment is available.

The chief drawback to the class E6011 rod at the present time is that it is available only in 1/8 and 5/32 in. sizes. Right now there is emphasis in using large size electrodes wherever practical in order to lay down more pounds of metal in a given time and at less cost (see Table II).

More Positioned Welds

All parties have been advocating the use of larger arc welding electrodes wherever possible, meaning mostly on flat and horizontal fillet welds, since 3/16 in. is the limit on rod size for vertical and overhead welding. But even in overhead work, going from 5/32 to 3/16 in. increases the deposition rate 33 per cent. In down hand welding, changing from 3/16 to 1/4 in. has increased the deposition rate 75 per cent. Advantage of the larger rods can best be taken by positioning of the work. Frequently the use of a large diameter rod with a positioned weld allows the fillet to be completed in one pass instead of having to lay down three beads.

During the past year several positioners of enormous size have been built, sufficient to swing heavy weldments up to 40 ft. in diameter. Standard units are available that will handle work weighing up to 20 tons. The diameter of the work they will swing is largely limited by the height of the machine from the floor. Some plants have combined high mounting with a pit alongside the positioner to increase the swing.

A huge quantity of welding positioners have been built and sold during the past year. There are literally thousands of them in the Detroit area alone working on the combat tank jobs. Diesel engine bases are being welded on big positioners and there is one large machine that will swing an entire naval gun mount for a battleship turret.

"Hot" Electrodes Favored

With emphasis on speed of arc welding and higher deposition rates, plus the wider use of positioners and positioned welds, even for the largest work, there has been a marked trend toward the use of the so-called "hot" electrodes like classes E6020 and E6030. These rods have heavy all-mineral coatings that produce fluid slags, limiting them to flat position and fillet work. These two classes of electrodes can be safely used with much higher currents than any other rods without danger of overheating the rod to the point that the stub has to be discarded long before its useful life is expended. The deposition rate is highest of any of the AWS classifications. Deep penetration is obtained, particularly at the higher welding speeds.

A new technique for arc welding at higher speeds with these hot rods was announced by a leading producer during the year. Several other welding equipment makers had been privately advocating similar procedure for the past several years, and now all are on the bandwagon. Essentially, the technique consists of:

(1) Changing the angle of the electrode with relation to the work.

(2) Increasing the rod diameter and amperage.

(3) Increasing the welding speed.

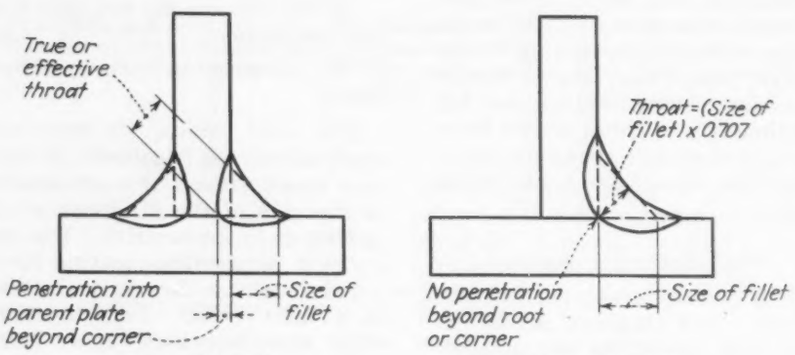
For fillet welds, its principal application, the electrode is held in a plane almost at right angles to the axis of the fillet and at 45 to 60 deg. to the vertical. The arc is held short—the coating just about touching the vertical plate in a fillet weld. This together with the increased speed and higher amperage gives deep penetration and a smaller fillet. Essentially, the rod is a class E6020, one of the hot rods just described. Because more base metal is melted and penetration goes well inside the corners, a 1/4-in. fillet as measured by a gage, will do the work of a 3/8-in. fillet when conventional practice is followed. Increases in deposition rate of 100 per cent are possible and 50 per cent increase in welding speed is not abnormal.

TABLE II

Effect of Electrode Size on Economy

Electrode size, In.	1/8	5/32	3/16	1/4	5/16	3/8
Amperes	110	130	150	250	325	425
Arc volts	24	25	26	30	34	38
K.W. at arc	2.64	3.25	3.9	7.5	11.1	16.1
Consumption rate, lb. per hr.	2.6	3.3	3.95	7.5	10.7	16.2
Deposit, lbs. per hr. (50% operating factor)	0.87	1.1	1.32	2.5	3.57	5.4
Efficiency of set, per cent	47	50	51	55	59	59
Kilowatt input	5.6	6.5	7.65	13.65	18.8	27.3
Interruptions per lb. consumed	18	12	8	5	3	2
COST PER POUND DEPOSITED						
Labor	$1.150	$0.909	$0.758	$0.400	$0.280	$0.185
Overhead	1.150	0.909	0.758	0.400	0.280	0.185
Power	0.064	0.059	0.058	0.055	0.053	0.051
Electrode	0.150	0.135	0.127	0.127	0.127	0.127
Cost of interruption (including overhead)	0.030	0.033	0.022	0.014	0.008	0.005
	$2.564	$2.045	$1.723	$0.996	$0.748	$0.553

Already the process has been accepted for shipbuilding by the American Bureau of Shipping, the Maritime Commission and Lloyd's Register of Shipping. Navy Department approval has yet to be obtained. Wider general use of the technique awaits acceptance by designers of the smaller fillet for equal calculated strength. For equivalent or slightly superior joint strength, less electrode material is required because more of the base metal is melted with the deep penetration obtained. Therefore the fillet, as measured by a fillet gage, is smaller, although actually the effective throat is larger. (See line drawing).


True or effective throat
Penetration into parent plate beyond corner
Size of fillet
FAST WELDING TECHNIQUE
Throat=(Size of fillet)x 0.707
No penetration beyond root or corner
Size of fillet
CONVENTIONAL CONCAVE FILLET WELD

BY using more current, holding the rod at a steep angle and welding fast with a so-called "hot" rod, it is possible to get a stronger joint with a smaller bead and hence less electrode material per foot of weld. Penetration is well beyond the corners. Conventional weld is at right.

In any argument of a.c. versus d.c. welding, the question of safety has been raised several times in the past year. The impression has been given that a.c. is less safe electrically than d.c. So far there are no reliable statistics that would bear out this contention. Welding fatalities are relatively few compared with other types of industrial accidents. What few have occurred almost invariably have been in hot weather when the operators' clothing and gloves were soaked with perspiration.

There was a lively discussion on this subject at the annual meeting of the American Welding Society in Cleveland last October. One theory advanced from the floor and not disputed there is that line disturbances often set up extremely high secondary open circuit voltages. Momentary use of a high kva. resistance welder on the line, for example, could readily cause an appreciable drop in voltage, resulting in a sudden decay in flux in the a.c. welding transformer core. It is this decay in flux that is said to produce high transient secondary current and voltage. There is danger to the operator only if his arc is broken at the time. This possible source of danger is recognized to the extent that users of a.c. equipment are warned to keep heavy momentary current consuming apparatus away from arc welding feeder lines.

During the year, a device was placed on the market for use with a.c. welders so designed that when the operator breaks his arc, even momentarily, all welding amperage and voltage is completely blocked out of his welding cables. A green light shows visually such a safe condition of the circuit and a red light signals when a full welding current is present and care must be exercised.

Open Circuit Voltage Halved

Very recently a heavy duty type of portable a.c. welder was put out that automatically cuts the open circuit voltage in half when the arc is broken. This is another answer to the question of electrical hazards. The new design utilizes two stationary primary coils and a movable secondary coil for adjustment of the output current. When the machine is idle, one of the primary coils is automatically cut out by a magnetic contactor. Each primary contributes approximately 42 volts to the total open-circuit voltage, which is actually 85 volts. Thus a relatively high voltage is available for starting the arc with heavily coated electrodes, but this immediately drops to a range of 32 to 40 volts during the welding period. Like the big transformers for the Unionmelt process, this machine, which is built in capacities up to 1000 amp., has built-in capacitors for power factor correction.

Submerged Melt Welding

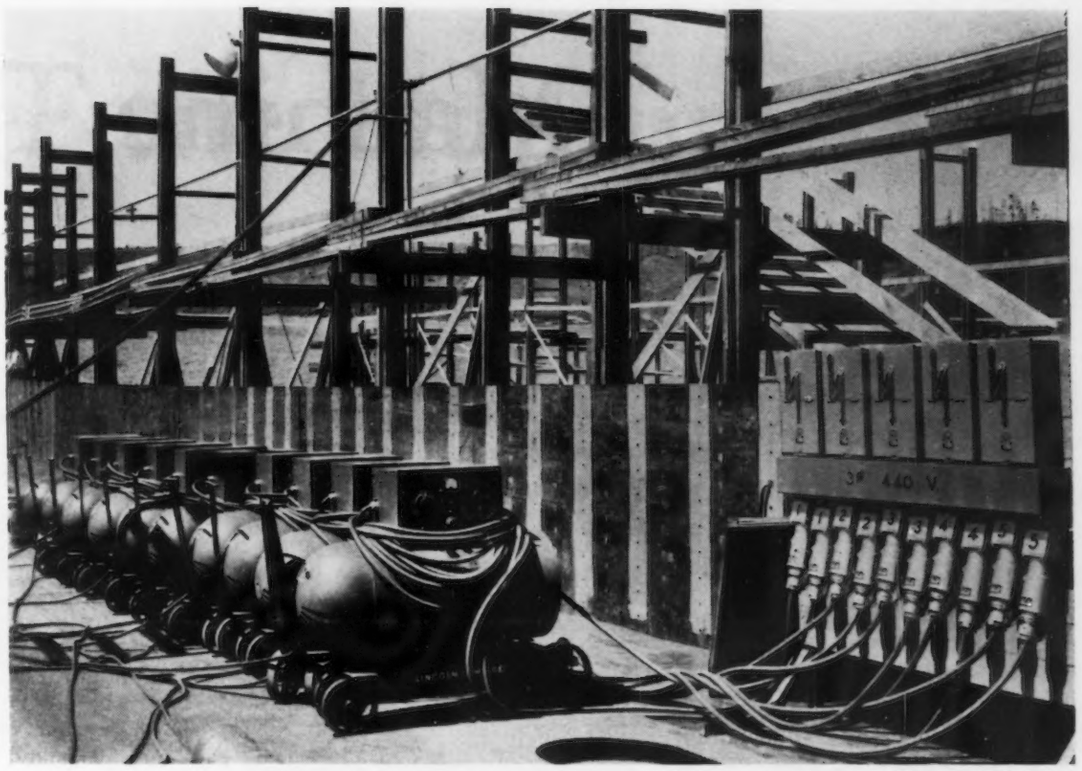
Since its first adoption by the Sun Shipbuilding & Dry Dock Co. in 1936, the application of the Unionmelt process of automatic submerged melt welding has spread steadily throughout the shipbuilding industry. Last year, as a result of the tremendous increase in yard capacity, the process received its biggest boost. Some of the larger shipbuilders put in 50 or more units at a time and now there is hardly a shipyard in the country that is not doing some of its flat welding by this technique. In this process, the arc action is smothered under a layer of granulated mineral and silica glass. Very high current is used—from 1000 to 4500 amp., depending upon the wire diameter—but there is no loss of metal from weld spatter. Weld appearance is excellent and the deposition rate is the highest obtainable. A not unusual rate is 60 lb. per hr. with ¼ in. wire. Although it is possible to use rod up to ½ in. diameter, most of the welding in shipbuilding is being done with 3/16 to ¼ in. wire.

The submerged melt process is obviously limited to flat and fillet work, necessitating a hand deposited bead on the bottom side of the plate juncture unless the work can be turned over. Good fit-up is absolutely necessary and this condition sometimes involves the use of elaborate and costly clamping fixtures to hold the plates or subassemblies in place, particularly if the plates are heavy.

Although originally applied to straight positioned welds or flat welds, these automatic units are now being applied to fillet welds in shipbuilding. One of the West Coast yards is welding both sides of vertical stiffeners in double bottoms with the aid of a pair of Unionmelt heads working from either side. In fact, there are two pair of heads on the large bridge structure, which spans the subassembly area, and each pair works toward the keel. Welding speed is about 30 in. per min.

By far the greatest percentage

• • • The Japs reported P-T boats in the Philippines flying through the air with flapping wings shooting guns and torpedoes, which is somewhat of an exaggeration. Even so, P-T performance has greatly exceeded the dreams of enthusiasts.



RIGHT

BY the tens. Some shipyards have 500 or more single operator d.c. welders in use on Maritime Commission cargo ship construction.

Photo Lincoln Electric Co.

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BELOW

LARGE fixtures mounted on revolving positioners for facilitating downhand arc welding on the tail or tongue of anti-aircraft gun carriages. These fixtures were developed by the Fisher Body Division of General Motors Corp.

Photo by Wide World.

of welding in shipbuilding is still done manually with d.c. equipment, but the wide adoption of this high speed, high deposit rate automatic a.c. equipment has indirectly done much to speed up hand welding and to foster one of the high speed manual arc welding techniques mentioned earlier.

Chain Automatically Welded

Incidentally, there is as much wire going through the Unionmelt machines in the manufacture of ship chain as in the fabrication of the hull itself. In chain manufacture, the process is more akin to an electric melting furnace than a welding technique. Here the weld metal is actually cast into a copper mold which surrounds the joints of the formed chain link. The vertical pillar is formed at the same time out of cast weld metal. Making plug welds automatically is a similar application since the weld metal is simply fed into a drilled or punched hole.

Another big application of the submerged melt weld process has been to the new M-4 combat tanks in the welding of armor plate. Most of the hull assemblies can be handled on positioners, but the technique is limited to straight-

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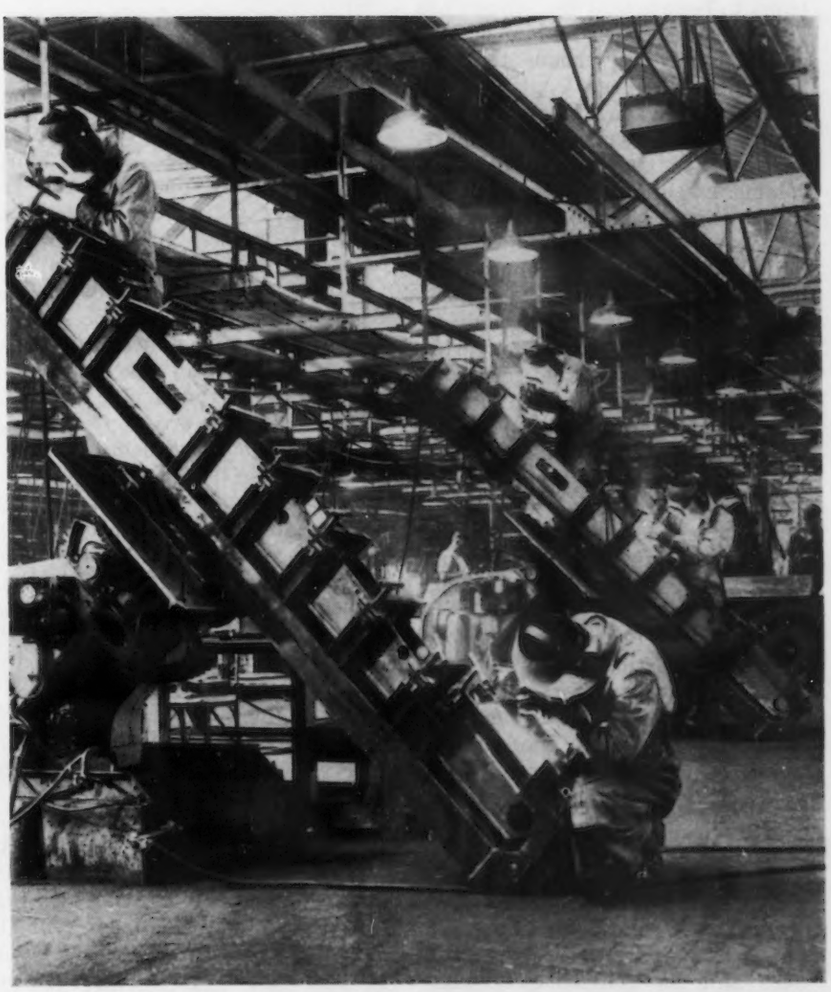
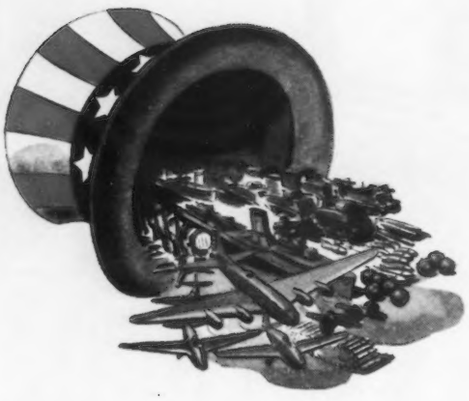


Machine Tools



ALTHOUGH monthly shipments of machine tools will continue to increase for some months this year, the fact that during the latter part of 1942, shipments were in excess of new firm orders leads many to believe that the industry is over the hump. This statement does not imply by any means that the industry will coast down grade from this point on. The backlog of orders is still over a billion dollars, or over five times the total 1939 volume, and the urgency to get out this business as soon as possible has not abated one iota. But many individual plants are in the unhappy position of having to whittle down their backlogs as rapidly as possible to meet urgent deliveries, while seeing only sufficient new business in sight to maintain about half the current rate of operations in the latter part of 1943. But with shipments in the first half of this new year expected to be in excess of the latter half of 1942, even a 50 per cent reduction in the latter half will still make 1943 a billion dollar year.

As the year 1942 drew to a close, the most drastic action taken by the Tools Division of the WPB relating to machine tool demand was the issuance on Nov. 5 of amendment No. 3 to WPB order E-1-b which originally placed machine tools under a limited allocation system on May 1. The original order allocated 25 per cent of monthly machine tool production to Lend-Lease and essential civilian needs and the remainder to the armed services and the Maritime Commission. There was a further subdivision of the 75 per cent as between Army, Navy, Air Force and Maritime Commission requirements. With it went a new numerical master preference list, in which the order of priority by prime contractors was given. Amendment No. 3 set this list aside and allowed aircraft contractors literally to take their pick of machine tools scheduled for shipment in the next four months.

At the same time the whole aircraft production program was examined in the light of actual needs and equipment requisitions were balanced in line with actual production requirements. At the height of the tooling phase of the program of doubling our aircraft output, when pool orders were made use of almost 100 per cent, a great deal of over-ordering was done. There have been instances where only half the machines of a certain kind, say milling machines, were needed for a particular group of operations. The orders for the surplus machines are being cancelled. At the same time an attempt is being made by the WPB to balance shipments to various projects and as a corollary to balance to some extent the backlogs of individual machine tool builders. If 90 per cent of the equipment on a specific aircraft project will be delivered by March 1, for example, and deliveries on the remainder are scattered through April, May and June, the new amendment enables shipment to be demanded on these final 10 per cent by March 1, regardless of what other orders may stand on the order boards of the companies involved. The only provision is that the total quota of 75 per cent for our armed services shall not be exceeded, but aircraft can get 100 per cent of this allotment in any one month if need can be demonstrated for earlier delivery than originally scheduled.

How amendment No. 3 is affecting backlogs of individual companies is exemplified in the case of one prominent machine tool builder who had aircraft orders loaded on his order books at a fixed per cent of his capacity all through 1943 and well into 1944. Orders from other branches of the services and the Maritime Commission, however, did not extend beyond June, 1943, and these did not absorb all the assigned capacity for these services. The changes in the order board as a result of the amendment to E-1-b practically have been to double the percentage assignment of aircraft orders each month and to clean them out in six months instead of 16. It probably would have happened that way in any event, if the other branches of the government continued at the present level of ordering or cancelled a portion of existing orders, as many of them have been doing.

Other Programs Curtailed

When the government decided to give the "green light" to the aircraft industry, there was a drastic reduction announced in some of the ordnance programs. Combat tank output was cut materially, a large Midwestern project for making tank armor was cancelled and many shell contracts were dropped after much of the contemplated machinery had been lined up. Together with the screening of aircraft orders, for some machine tool builders this has resulted in substantial cancellations of orders. For the industry as a whole, these cancellations have not amounted to more than 2 per cent of unfilled orders a month, according to the War Department in a statement issued in December. Not much new business is looked for from ordnance manufacture except for new and unforeseen shifts in combat weapons and in replacement, which should be substantial

Over the Hump . . .

. . . The machine tool industry finds itself in the anomalous position of continuing to increase its monthly output in the face of declining orders. Many signs point to the end of the major tooling programs, but fill-in-orders will be plentiful. Shift to other products being studied.

as a result of the wear and tear of seven-day a week operation, often with "green" help.

Besides, many of the small arms programs were tooled up on existing equipment or used equipment picked up from various sources because at the time new equipment was unavailable in time to meet product delivery dates. One of our latest hand weapons, for instance, was tooled up largely on equipment of Spanish American War vintage and earlier. Such plants offer replacement markets for machine tools.

Equipment for the expanded aircraft program has largely been ordered, particularly as regards engine manufacture. In fact, this is where some of the over ordering has taken place. Much of these tools remain to be delivered, however. Current new orders are coming from propeller manufacturers and from the airframe or fuselage builders, whose normal requirements run much more to presses than to strictly machine tool. It should be noted that a great many of the new aircraft facilities took months to get rolling even after most of the equipment had been installed. Their effectiveness is only now really beginning to be reflected in increased output.

Backlogs to be Adjusted

In early December, the Tools Branch of the WPB indicated that it would inaugurate a policy of relocating backlogs of machine tool orders to speed the production of machine tools for aircraft manufacture. The policy had been advocated by the Army and Navy Munitions Board for some time. Studies were started by the Tool Branch with a view to determine what orders could be relocated with a minimum of disruption of the industry's financial structure. Relocations that would impose undue hardship will not be undertaken and those that are made will be done as painlessly as possible. However, if there are 10 companies making a certain type of tool, the WPB does not want five of them to have all the orders, particularly since these five will be quoting deliveries up to a year or 18 months hence, and the less favored group will be in a much more prompt position regarding deliveries.

It is not always the small, obscure company that hasn't the orders while the big names in the industry corral most of the business. Some of the largest producers have gathered such momentum in production that on certain standard sizes they are in a position to make delivery of 25 to 30 standard machines, practically from stock. Yet the industry backlog of undelivered orders averages over seven month's production. It is obvious, therefore, that the situation is very spotty. One company, as another example, has over a year's business ahead making highly special purpose equipment for the aircraft industry, but is actually out looking for business on a standard line of high production machines it also makes.

It is only reasonable to expect that excess plant capacity, where it develops, will be used for the manufacture of parts for planes, tanks, guns or other munitions—or for the manufacture of parts for other machine tool builders making machine tools for which there still remains an extreme demand. The extent to which this may materialize will depend naturally upon factors having to do with manpower, with materials, with the shifting fortunes of war and with many other factors which of necessity are uncertain. No specific predictions can be made.

Machine tool builders, especially in the building and designing of special-purpose machines to meet the unexpected exigencies of war production, have shown a capacity to move swiftly into the production of items beyond their range of past experience. They have demonstrated their capacity to adapt their productive facilities to the use of new and different materials. Certainly they would seem in line for the manufacture of various items of war materiel, when and to the extent that a decline in machine tool demand makes a portion of their facilities available for this purpose.

On the other hand, some of the more pessimistic leaders in the industry believe that by the time they have completed the war tooling program and have reached the replacement stage, there will be no more direct war contracts available to maintain their capacity. More optimistic machine tool builders have been looking over and studying all kinds of indirect war production that their facilities are capable of taking over. One manufacturer is considering making the special cutters that are used with his equipment so as to get into the "razor blade" end of the business when machine orders are sharply curtailed.

Flexibility Needed

Another side of this picture was presented by George H. Johnson, now head of the Tools Branch of the WPB, in his retiring presidential address before the National Machine Tool Builders Association. Speaking before the association in October, he expressed the proposition that in time of war the nation's capacity to fabricate materials should be greater than the total

supply of available materials in order to maintain a substantial degree of production flexibility. In order to be able to shift production emphasis from planes to tanks, to guns, to ships or whatever is most important from the military point of view, it is necessary, he said, to have excess capacity in all these lines. Similarly, he believes that to meet shifting machine tool demands, we must have maximum facilities for manufacturing all types. This would still be necessary, he maintained, even if there were not enough materials for all plants to operate continuously. The critical demand for any one type of machine tool could not be met by trying to adapt or shift to that purpose, facilities designed for manufacturing a different type.

Industry Heads in WPB

More than ever the Tools Division of the WPB is being run by members of the industry itself. Mr. Johnson, director, is president of the Gisholt Machine Co. and is immediate past president of the National Machine Tool Builders Association. His deputy chief is John S. Chafee who had been elected to succeed him as association president last October. Mr. Chafee is a former vice-president of Brown & Sharpe Mfg. Co. Other leading figures in the Tools Division have been drawn both from builders and dealers in machine tools. As a result of this integration of the industry with the WPB, the government and the machine tool industry are closer to a mutual understanding and solution of the nation's machine tool war production problems than has ever before been the case.

The industry has already accomplished a large share of the great production job it was called upon to perform. Now Washington is beginning to consider what may happen to the industry when the job of retooling America for war has been completed and machine tool builders will have settled down to the job of supplying only the machine tools necessary for such new projects as will most certainly develop and for the maintenance of the war production program. How far off this may be is still a debatable question. The industry still has a backlog of over a billion dollars, representing on the average, nearly eight months' output on the present production basis. However, this industry average is not the answer for any individual company. As has been indicated, the changed requirements will come to some companies earlier than in others. Some companies have already felt a decided slackening in some lines and are seeking new business, while other divisions of the same firm are still working against huge backlogs.

First to Get Started

Machine tools felt the impact of war long before most industries. Even before Hitler was on the march, orders for machine tools for war production purposes were pouring in from England and from France. With the advent of our own national defense program the demand for machine tools for the manufacture of weapons and other war materiel stepped up at a constantly accelerating pace.

The plant expansion phase of the machine tool industry, therefore, was well under way long before Pearl Harbor. In fact, the major share of plant expansion had been completed by that time—and the early summer of 1942 saw the nation's machine tool plants set up to meet maximum war needs as far as plant and equipment are concerned.

Similarly, the production record of the industry in 1942 was, in the main, simply a continuation of the remarkable upward trend which had been in evidence ever since 1939 (see chart). In that year, shipments amounted to approximately $200,000,000. In 1940 they rose to $445,000,000; in 1941, to $775,000,000; and 1942 shipments are estimated by the National Machine Tool Builders' Association in the neighborhood of $1,300,000,000.

This remarkable upturn is accounted in part by expansion in plant and equipment and by maximum utilization of plants and facilities not fully used at the beginning of the war. It is accounted for in part by the building up of a three-shift system of continuous operation.

All important in making possible the remarkable increase in output was the industry's program of job analysis and job simplification which broke down jobs into their component parts and thereby enabled machine tool builders to reduce the training period to the minimum and get "green hands" actually into production within from three to six weeks.

Before the war, machine tool builders used to say that it took at least three years to make an all-round machinist, and that as a rule no new employee was worth his salt until he had been in the plant at least a year. But in those days, when volume was small, it was considered necessary that each operator should know how to perform a variety of operations, and should also know how to set up his machine for various operations.

But with war production—with orders for identical machines coming through in large lots—it was possible to split the job up into simple components. This meant that an untrained "green hand" did not have to know either how to set up his machine or how to perform a variety of operations. All he had to be taught was how to run one particular machine on the same job all day long—a machine that had been set up by an experienced man.

Of course this was not possible in the building of special-purpose machines—a story which constitutes one of the brilliant chapters in machine tool war production history. But on the whole, this principle was to a large extent responsible for the surprising increase in output achieved by the industry—an increase which is out of all proportion to the degree of plant expansion and the degree of continuous operation.

Women Employed

Fortunately, the industry had, to a large extent, completed its program of job simplification by the middle of 1942 and was therefore in a position to face, with minimum difficulties, the employing of women, which became necessary due to losses incurred through the draft and through enlistments. During the latter half of 1942 the employing of women in machine tool plants continued at an accelerated pace, particularly in the larger plants.

Far more difficult from a personnel standpoint has been the situation with respect to supervisory personnel. Supervision is not a job which can be broken down into simple component parts. It takes months, even years, to train a competent supervisor. Furthermore, new men and women quickly trained to perform one simple part of a job cannot function competently unless they have adequate and efficient supervision.

As 1942 drew toward a close, supervision became one of the industry's gravest problems. It seemed well-nigh impossible to upgrade sufficient people from the plant floor in time to take the place of supervisory personnel losses by enlistment and by draft. This situation bids fair to be still more acute

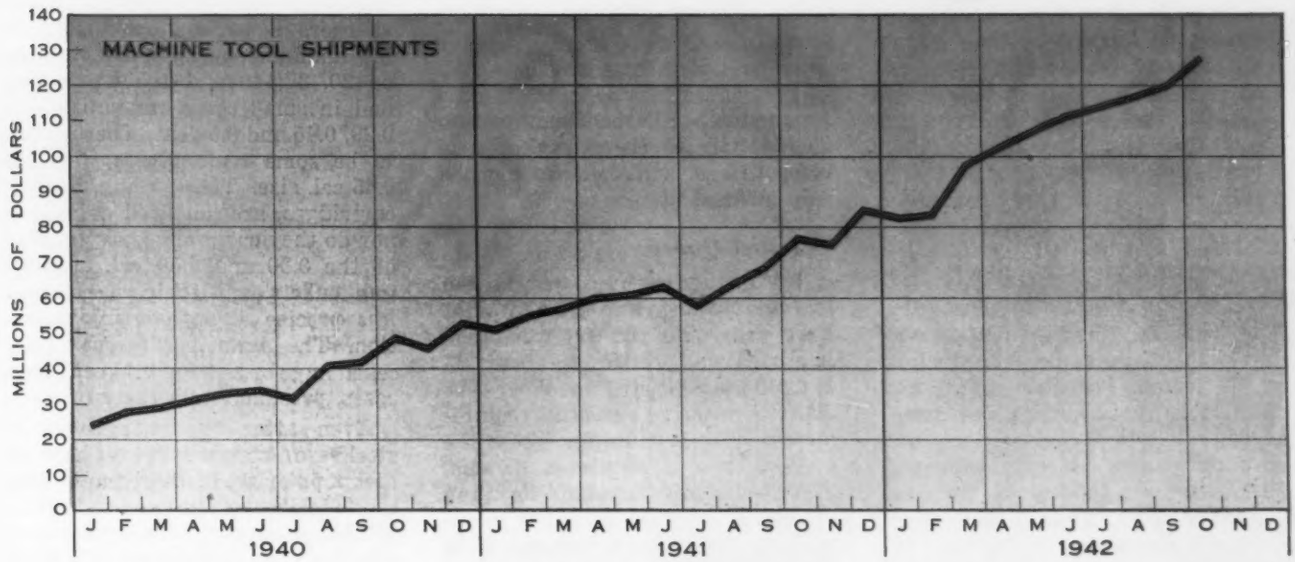
in 1943—unless there is a more constructive attitude taken by the government with respect to the deferment of key supervisory personnel.

Material Substitutions

An equally aggravating problem has been that of materials. The industry has made substantial progress in the substitution of less critical materials for those of more vital immediate importance in the manufacture of direct munitions. The industry has substantially decreased its use of alloy steel, copper, aluminum and rubber. It has successfully substituted some of the national emergency steels, and in some cases carbon steels, for some of the alloy steels which are today in particular demand.

One machine tool builder has been very successful in induction hardening shaved SAE 1045 steel gears in place of the original through hardening nickel steel gears and more recently the new National Emergency steel substitutes. The same manufacturer is using SAE X1340, a free-cutting shell steel, for spindles. Another builder has brought out a war model of a heavy duty turret lathe, employing a high test iron spindle, cast iron headstock gears and mild steel pinions.

In general, the industry went over the NE8000 series steels in the initial phase of substitution. These steels worked out more satisfactorily than some of the skeptics had expected. Now the industry is faced with a shift to the lower alloy NE9000 series steels. Through an industry group committee, tests on gears made of several analyses of this series are being carried out. When the results are known, recommendations will be made to the industry on gear steels and the WPB Steel Branch will be asked to cooperate in seeing that warehouses in machine tool districts are permitted to stock such steel in sufficient quantity to take care of the industry's needs. Except for about 15 or 20 big makers, the machine tool industry is composed of small manufacturers who obtain most of their steel requirements through local jobbers.



THE steady upward trend in dollar volume of machine tool shipments continued throughout 1942. Total shipments for the year are estimated at $1,300,000,000 as compared with $775,000,000 in 1941 and with $445,000,000 in 1940. Pressure to get out the billion dollar backlog of the industry will continue to boost shipments for some months to come, despite a falling off in orders.

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On the basis of present production schedules, it is estimated by the National Machine Tool Builders' Association that the industry's total steel requirements represent only 7/10 of 1 per cent of the nation's total steel output. In view of the vital part which machine tools play in the manufacture of war materiel and the continuing urgent need of machine tools to complete the nation's tooling up for maximum war effort, the allocation of sufficient materials for the industry remains a matter of crucial importance.

Another phase of the situation that the government has not overlooked is maximum utilization of existing machine tools. Around the first of July, the Critical Tools Service was set up by the WPB and in the past six months this branch has been ferreting out equipment that is being used on war work only part of the time. The bogey of 100 per cent utilization has been set at 168 hr. (7 x 24 hr.), but in practice no attempt is made to put additional work on machine tools that are in use over 120 hr. per week. Through biweekly reports of available hours on critical machine tools in 12 of the 13 Ordnance Districts, much of the idle capacity of small plants has been put to work. By their very nature, these small shops use general-purpose equipment which can readily be converted from one job to another from day to day if need be.

Although the Critical Tools Service has stayed away from the large prime contractors, it has plans for covering this phase of the picture when reduction of certain ordnance programs leaves equipment idle that can be diverted to some other work. During October this branch was instrumental in placing over $1,500,000 worth of work a day on idle equipment.

Manpower shortages have complicated this conversion program to the extent that not all idle machine hours can be matched with available operators. Data are now being reported on available operators for idle equipment. No attempt has yet been made by prime contractors to supply operators for idle equip-

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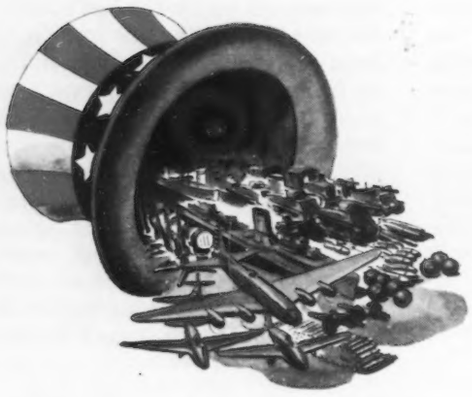
NON-FERROUS



ALL the common non-ferrous metals have become precious metals, sought after and hunted down, cherished and pampered, aliens to thoughtless use and ordinary ends. Except silver and lead, they are inadequate for even essential needs. Four of them, magnesium, aluminum, copper and tin are most urgently needed of all materials.

Paradoxically, they have never been more plentiful than in 1942. Except for tin, their rarity is due entirely to huge demands, ballooning month by month.

To teeter these enormous, swift demands into balance with supply, everything has been used except transmutation. Allocations, reclamations, requisitions, restrictions, prohibitions, substitutions, premiums, Indian giving, capacity building and manpower freezing have all clattered into the scale. New tricks of patching, pruning and eking are constantly adding their ponderosity.

Some of these will be thankfully forgotten when the war ends. Others, like electrolytic tin plating, steel cartridge cases and silver coated bearings will contribute change in the changed peacetime world. The new non-ferrous production and fabricating capacities of 1942, alone, cannot help but drastically alter the world of metals and the world of everyday things. The implications of new magnesium production are beyond imagination. The social reverberations of new competitions and controls can be only guessed at.

The Red Queen:

The quantities of copper needed to wage modern war are fantastic. Last year this country produced, imported and retrieved about 2,571,700 tons but still was 8 per cent short of meeting essential requirements. With ammunition by far the largest user of copper—a 37 mm. anti-aircraft gun accounts for a ton of copper every 20 min. it is in operation—the metal's biggest *if* is the substitution of steel shell and cartridge cases for brass.

As a matter of fact, the prospective substitution is not so much an *if* as it is a *when*. Steel cases can be made. The Germans and Russians use them with varying results, and this country is successfully turning out cases, but with performance dependability still discouragingly marginal. A few bad cases out of every hundred, cases that jam or split, represent anything but over-all success.

The problem will almost certainly be solved this year, possibly early in the year. One Ordnance Departmet official has now named July as switch-over time, but this is guesswork. The Department has been running a cycle of hope, guess and disappointment since last June. In September it told at least one large brass case maker to convert for steel cases by December. The disappointment segment of the cycle then swung round, and the plant's equipment requisitions have not yet even been O.K.'d.

Twenty-two companies are said to be experimenting with the steel cases, many of them ready to go into large scale production as soon as there is some point to it. In big ammunition, they are working on 20, 37, 40 and 105 mm. cases, and in small arms ammunition on 0.30, 0.45 and 0.50 cal. There seems to be some real success with the 0.45 cal. size. These, being revolver cartridges, are not fired as rapidly nor do they carry the heavy charge of the 0.30 and 0.50 cal. machine gun bullets, and their cases are a less precise manufacturing operation. The Army has recently cancelled huge orders for 0.45 cal. brass cases, presumably in favor of steel.

Even after the changeover to steel cases, copper will still have all the popularity it can stand. One type of fighter plane uses more than 800 lb. of copper, a flying fortress uses 1½ tons, a scout car 150 lb., a medium tank 600 lb. The Navy must continue to have brass cases, rather than steel. The Signal Corps alone needs 5000 tons of copper every month for communications equipment.

In the brass mills, the heaviest burden throughout the year was on strip metal, principally because of ammunition needs; wire and sheet demands were relatively light, as light went in 1942.

Until February, when allocations were adopted, the brass mills had to scramble for copper. Lately, slab casting capacity has been the snag. Practically all the mills have increased their electric furnace capacity, but it is still out of balance with rolling equipment.

This is because in ordinary times brass strip, destined for lipstick containers, ashtrays and other lightsome trifles, is usually 0.005 to 0.050 in. thick. Strip for 0.50 cal. cartridge cases is 0.160 in. thick; for artillery cases it may be as much as ⅝ in. This heavy strip requires much less rolling, so that casting departments, though they

METALS . . .

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By J. I. BUTZNER
Associate Editor, THE IRON AGE

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. . . Besieged with demands and awhirl with expedients, non-ferrous metals were the belles of 1942's macabre ball. Some of them will never be their old selves again.

work day and night, are harried by demands for more from partly idle rolling mills. Considerable load has been or will be taken off the casting departments by the installation of a number of continuous casting machines to supply the large tonnage of extrusion rounds required today.

Five new Defense Plant Corp. ordnance plants and brass mills went into production in the spring and early summer. Western Cartridge Co. manages the one in St. Louis, Bridgeport Brass Co. in Indianapolis, American Brass & Copper in Kenosha, Wis., Revere Copper & Brass, Inc., in Chicago, and Chase Brass & Copper Co. in Cleveland. The Cleveland plant, while it is producing brass, is said to be using none of it in the fabrication of shell cases as originally planned. The fabricating section is reported working on steel case development and preparing for full production on steel. On the other hand, the St. Louis plant is said to be using 1,000,000 lb. of brass a day, and the Chicago plant 8,000,000 lb. a week.

At the beginning of 1942, most infant copper alloys had been deprived of research and experimental attention and had been lovingly put away for the duration. At least two of them, however, Chase Brass & Copper Co.'s tellurium copper and its new bronze alloy, No. 149, were found to be needed in several war production holes, and were pushed out of retirement into zooming careers.

Tellurium, which has been best known as a lead hardener, is used by Chase to make a copper alloy high in machinability and electrical conductivity, two qualities which had been mutually restrictive. The alloy's principal war uses are in electric cable connectors and in welding and cutting torch tips. By the hundred million, cable connectors are used in planes, PT boats, tanks and automotive equipment. At first they were made of silver plated brass. When the plating wore off as it did, especially in planes, from constant cable inspection, the conductivity was cut down to brass's figure of 26. It is believed that connectors of this type will, after the war, be used in all sorts of household electrical equipment and in passenger automobiles. In welding and cutting torch tips, the new alloy is replacing leaded copper, the machinability of which was frequently too inconsistent for such precise work.

The new No. 149 bronze, just going into production, is aimed for the same fields as phosphor and aluminum bronzes, with their contents of critical tin and aluminum. No. 149 is 88.5 per cent copper, 1.1 nickel, 0.22 phosphor, 0.5 tellurium and 9.68 zinc. At present it is being made at a rate of only 50,000 or 60,000 lb. a month, due to lack of equipment, but in four or five

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POURING bronze castings in the Cramp Brass & Iron Foundries division of Baldwin Locomotive Works.

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months is expected to go into large scale production.

Tin shortages forced Hamilton Gear & Machine Co. to replace the copper-tin-nickel bronze it has since 1934 considered best for worms and gears. The copper-nickel-antimony bronze finally evolved will carry 25 per cent more load or will run about 15 deg. F. cooler at the same load. The surface either does not need cold working or cold works instantly under overload without damage, since double the rated full load can be immediately applied to a new gear without causing prompt destruction.

Nearly everybody with any sort of copper mine claim apparently opened it last year and started it working. Mines closed for years, mines that had previously enjoyed only a conversational existence, began to be furrowed, pitted and pocked. Though fifteen companies supplied 98½ per cent of this year's million-ton domestic output, the other 1½ per cent came, astoundingly, from about 2500 submarginal mines, producing for the 5c. a lb. bonus established by Metals Reserve early in the year.

The biggest mine expansion was at the Morenci properties of Phelps Dodge Corp. Calumet & Hecla Consolidated Copper Co. reopened high cost Michigan mines. Two of the more important mines to be worked for the first time on a commercial scale are those of Castle Dome Copper Co., a division of the Miami Copper Co., and the Bagdad Copper Corp., both in Arizona.

Two domestic smelters began producing fire refined copper in substantial quantities—Phelps Dodge at Morenci and Kennecott Copper Corp. at Chino, N. M. Fire refining at both these mines is feasible because the ore does not contain valuable by-products.

How much the government paid last year in over-quota bonuses was kept a deep secret. Nor were quota figures made public, obviating squabbling. Almost all companies claimed, however, that the figures were set too high, and when wage raises were ordered by the War Labor Board in September, the OPA agreed to revise quotas downward so that the added costs might be met through premiums.

Manpower trouble was, and is, probably more serious in the copper industry than in any other. Five thousand tons in June, another 5000 in July, were lost because of mine and smelter labor shortages, it was reckoned. Manpower freezing in the western mines, pay increases, curtailment of drafting, furloughing of soldier miners, employment of women, closing of gold mines, and luring of labor from as far afield as Birmingham and Alaska were all tried. None of these, alone, seems to have been particularly efficacious but their accumulated effects helped for several months. By December the problem was acute again, and the expedient currently favored is the importation of Mexican workers.

The Metals Reserve copper stockpile is probably about a month's supply, and indications are that it has been about that throughout the year. Occasionally, when shipments from South America were delayed, stocks were temporarily withdrawn.

More than half a million tons of last year's copper came from South America. An undisclosed amount of Congo and Rhodesian ore was imported but practically none of it was consumed here. After refining, it was shipped to England. England got most of Canada's production, although the Metals Reserve Co. took over management and subsidizing of the Britannia Mining & Smelting Co. at Howe Sound and the Granby Consolidated Mining Co. at Copper Mountain, in return for the output, which, because of labor shortages, had dropped to a fraction of their combined capacities of 9700 tons of ore a day.

Last year 31 per cent of the country's total copper supply, about 797,227 tons, far more than ever before, was from scrap. Some of this, lately, has been salvaged shell and cartridge cases from the war fronts. The government has liberalized its specifications sufficiently so that a good deal of scrap which was snooted earlier in the year is now being used. Still greater liberalization is imperative, brass producers say.

In November, recovery of gilding metal scrap was begun at Calumet & Hecla's Lake Linden, Mich., plant, at a rate which will soon reach 2500 tons a month. This scrap is a bimetal used since late summer in increasing quantities for bullet cups. Formerly cups were of solid gilding metal, but the present practice is to make them 80 per cent mild steel and 20 per cent gilding metal coating. Under Calumet & Hecla's cupric ammonium carbonate leaching process, the 90 per cent of copper in the coating is recovered, but the 10 per cent of zinc is lost.

The handling of this scrap is delightfully neat. It is shipped from the fabricator's in lacey rolls, is treated in rolls, and the denuded steel scrap is charged, still in rolls, into open hearths. By May, production of the scrap is expected to reach 11,000 tons a month. So far, only Calumet & Hecla has been designated to receive it, but other plants and processes are being studied.

The Copper Recovery Corp., a Metals Reserve subsidiary set up in July, has contributed about 40,000 tons of scrap and is putting the finger on another 32,000 tons which the holders have been loath to lose. CRC is a planner's paradise. It set itself the stupendous job of listing all idle and excess copper inventories in the country and getting them moving, as-is when possible, as scrap when not.

. . . For puncturing the enemy's air cover. This anti-aircraft crew is all slicked up and on its good behavior, but when the going gets tough the bursts will be up there to rock the Axis.

It has worked too. More than 13,400 tons have moved as-is, much of it on emergency call. A pile of punch cards goes into one end of an I.B.M. machine, and out of the other end comes data on where, in a particular area, copper of a particular size, shape and specification can be found. Frequently the material has reached the war producer in a matter of hours. By the end of the year, CRC had inventory reports from 80,000 copper holders, and expected to hear from about 20,000 more.

Of course this wasn't possible without considerable paper work on the part of copper holders. Nothing, it seems, is possible without considerable paper work, a lot of it for the most nebulous ends. The industry appeared to be resigned to all its wartime government controls, to its temporary loss of voice in policies it had decided since time immemorial, but it remained popeyed and protesting at the multitudinous studies and statistics it was drag-

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ged through, the mountains of paper work in octuplicate. The pen, in some ways, was more aggravating than the sword.

The Beanstalks:

Aluminum and magnesium came little and late to the family of metals, but they are telescoping generations of growth into two years. By the middle of this year they will hold haughty rank in the hierarchy of bigness. Aluminum will be produced in quantity second only to copper among non-ferrous metals; its production will have increased almost seven times over 1939's. Magnesium, after a stunted childhood, will have shot to a hundred times its 1939 production size.

U. S. magnesium, which under the present expansion program is to reach about 700,000,000 lb. annually, is being produced by three processes: electrolytic, ferrosilicon, and carbothermal. The first method will contribute about 70 per cent of production, the second about 20 per cent, and the last about 7 per cent The remaining 3 per cent will be produced by what the WPB magnesium and aluminum branch calls "semi-experimental processes." (A thermal process to extract magnesium from olivine and dunite with ferrosilicon as an intermediate step; a carbothermal process using molten lead spray as the cooling and collecting medium, being tried by Dow; another carbothermal process using oil cooling, which Ford is working on.

Not much is known yet of the costs and relative economic feasibility of these processes or that of the various plants. By the end of the year, however, it is expected that costs will be figured to the tenth of a cent and by the middle of the year enough will be known to permit pretty good guesses at the viability of the separate projects. These cost figures will be of added interest since they will be the first on magnesium and aluminum production to which the public has had access.

The young and lively history of U. S. magnesium production can be largely told in the roll-call of expansion program plants. Those which began production in 1942 are:

Electrolytic

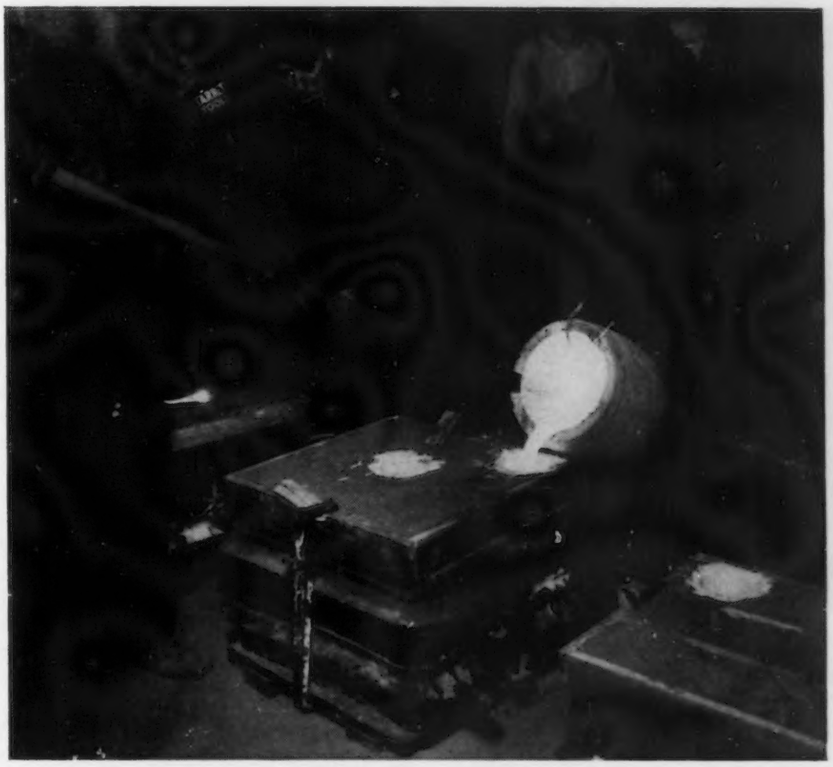
Diamond Magnesium Co., a subsidiary of Diamond Alkali Co., Painesville, Ohio
International Minerals & Chemicals Corp. (Union Potash Co.), Austin, Texas
Basic Magnesium Co., Las Vegas, Nev.
Dow Chemical Co., Velasco, Tex.

Ferrosilicon

Ford Motor Co., Dearborn, Mich.
Permanente Metals Corp., Manteca, Cal. (in addition to the major, carbothermal Permanente plant)
New England Lime Co., Canaan, Conn.
National Lead Co., Luckey, Ohio

Carbothermal

Permanente Metals Corp., Manteca, Cal.



MONEL metal (nickel-copper) is poured into a propeller mold at International Nickel Co.'s Bayonne foundry.

Those which will come in this year are:

Electrolytic

Mathieson Alkali Works, Lake Charles, La.
Dow Chemical Co., Marysville, Mich.

Ferrosilicon

American Metal Co. (Amco Magnesium), Wingdale, N. Y.
Electrometallurgical Co., Spokane, Wash.

All of these except Permanente are DPC plants. Magnesium expansion is costing DPC $370,511,-118. Permanente, Henry Kaiser's plant, was financed by Kaiser, largely with RFC funds. The only company producing pre-expansion magnesium was Dow Chemical Co., Midland, Mich. At the time expansion began, Dow was also building a plant at Freeport, Tex., jointly owned and financed by the company and the British government.

The largest of the new plants is Basic Magnesium's with a capacity of 56,000 tons. It is a vastly blown-up replica of the 5500-ton British plant of Magnesium Elektron, Ltd., which, like the Dow process, depends on electrolysis of fused magnesium chloride. Unlike Dow, however, which uses brine as a raw material, Magnesium Elektron uses ore. Basic Magnesium is getting its magnesite from deposits at Gabbs, Nev. Though this ore and the milling and calcining plant where it is converted to magnesium oxide sinter are only 325 miles from Basic Magnesium's plant, the railroad transportation route goes all around Robin Hood's barn, 1000 miles via Salt Lake City. Pilot plant tests are now being made with dolomite deposits only 15 miles from Las Vegas.

In October, Anaconda Copper Co. bought 52½ per cent of the management company of Basic Magnesium, the remainder being owned by Magnesium Elektron. Anaconda paid $75,000 for its part of the management company, a figure which somehow reached the Sen-

LEFT

WORKMEN in the floor molding department of American Magnesium Corp.'s Buffalo foundry pour a large magnesium sand casting for aircraft.

° ° °

OPPOSITE PAGE

NICKEL silver pouring from a 2400 deg. F. electric furnace into rotating molds.

ate's Truman Committee in the addled form of $75,000,000. The committee jumped to the conclusion that Anaconda had bought Basic Magnesium for this sum and, charging that the plant had cost $100,000,000 or thereabouts, worked itself into a fine flurry before re-reading its newspaper clippings and calming down.

The ferrosilicon process, developed by Dr. Pidgeon of Ottawa, is designed to furnish quick production with a minimum of power. Opinions differ on whether the process is practicable for peacetime. One pound of 75 per cent ferrosilicon is required for each pound of magnesium produced, which necessitated a new ferrosilicon construction program Calcined dolomite is mixed with pulverized ferrosilicon and is reduced, in a vacuum, at about 2100 deg. F. Production in the new plants is reported to be very satisfactory.

The carbothermal process used by Permanente is highly controversial, to say the least. It was developed by an Austrian, Dr. Fritz J. Hansgirg, and was unsuccessfully tried in Austria, Korea and England. At Permanente, a mixture of coke and calcined magnesia (from sea water) is heated to about 3800 deg. F. and the vaporized metal shock cooled with natural gas. Chemically, it is the simplest of the various processes, but it is potentially highly explosive. The process was abandoned in Austria and Korea after fatal explosions. As already mentioned, Dow is working on a variation of this process in which molten lead spray cools and collects the finely divided metal, and Ford is working on another in which oil cooling is used.

Permante's rated capacity is 24,000 tons a year, though original announcements made it 48,000 tons. Present production is approaching 50 tons a week; it is hoped capacity will be reached this spring.

The major magnesium use is for aircraft, with incendiary bombs second, and minor amounts going to alloys, powder and export. All of these uses have been steadily increasing, but incendiaries have had, relatively, the greatest growth. Small quantities are being exported to England; Russia has bought some but has not yet received any, though it is planned to ship magnesium there this year. All of Canada's output, produced by the 10-ton-a-day plant of Dominion Magnesium Co. under the Pidgeon process is used in Canada or shipped to England.

So far, magnesium is not used for stress parts. It is used principally as castings and sheet, with some extrusions and press forgings. Between 35 and 40 foundries have already been completed, or will be by the middle of this year, some of them DPC and some privately financed. Revere Copper & Brass is building a large sheet rolling plant in Maryland.

One of the uses for which magnesium has proved most valuable is in aircraft and artillery wheels. In addition to weight saving, the cast aircraft wheels provide rapid distribution of the heat generated intensely and suddenly on landing, with a consequent saving in tires. Because of high resistance to impact, it is reported that in English experience there have been practically no shock or impact failures. Resistance to fatigue and vibration is so great that the Germans use artillery wheels of cast aluminum with a small rim of synthetic rubber.

It is expected that by the end of this year, 5 or 5½ per cent of U. S. aircraft, by weight, will be magnesium. Visions of an all-magnesium plane received an impetus last year from Northrop Aircraft's new heliarc welding method. Northrop says such a plane is "beyond the drawing board stage," but it is still very much a dream plane and probably will remain so all through the war.

The aluminum expansion program, like magnesium's, will be finished this year, with peak production of 2,100,000,000 lb. (1,050,000 tons). Altogether, DPC is spending $666,718,307 on aluminum expansion. Six new ingot producing plants, in Arkansas, California, New York, Oregon and Washington (two), came into production in 1942. Three others, in New York, New Jersey and California will start producing this year. All are DPC plants and all are operated by Aluminum Co. of America except the Reynolds Metals Co. plant in Washington and the Olin Corp. plant, also in Washington. Reynolds

also has a plant in Alabama which began production in 1941.

An Alcoa-DPC alumina plant in Arkansas was completed last year and another in Louisiana will produce this year, bringing the number of U. S. alumina plants to five. Both new plants use low-grade, high silica domestic bauxite.

The roster of new plants for aluminum working is overwhelming. Because of censorship, only states can be given as location. The big plants that came into production in 1942 are:

Chevrolet Motor Division, Michigan, forgings
Bohn Aluminum & Brass Co., Michigan and California, extrusions
Extruded Metals Co., Michigan, extrusions
Buick Motor Division, Michigan, castings
Revere Copper & Brass, Inc., Maryland, tubing; New York, forgings
Ford Motor Co., Michigan, castings (two plants), and forgings
Chrysler Corp., Michigan, forgings and castings
National Bronze & Aluminum Foundry Co., Ohio, castings
Packard Motor Car Co., Michigan, castings
Servel, Inc., Indiana, castings
Aluminum Co. of America, Ohio, forgings and castings; Indiana, extrusions; New York, rods and bars; California, tubing and forgings.

In addition, Aluminum Co.'s huge sheet mill at Alcoa, Tenn., started operation late in 1941.

This year there will come into production:

Delco-Remy Division, General Motors Corp., Indiana, castings.
Aluminum Co. of America, Arizona and Pennsylvania, extrusions; Ohio, blooming mill; Illinois, sheets; Pennsylvania, forgings (two plants); Michigan, forgings; and Kansas, castings.

The Reynolds Alabama plant is the only one in the country that takes bauxite in at one end and ships fabricated products and parts out the other. One big advantage here is the quick scrap turnover. Of sheets, the major aluminum product, almost all of which goes to aircraft companies, 30 per cent becomes scrap. According to Reynolds, this keeps about 36,000,000 lb. of the metal tied up constantly.

Except for minor amounts going to the Navy, all aluminum output is now for aircraft.

In June, at the government's request, fabricated aluminum price cuts went into effect, ranging from more than 20c. a lb. on some of the higher cost fabrications to 1c. a lb.

In February idle aluminum stocks were called in by WPB. The year's harvest amounted to about 21,000 tons from 1600 companies, either sold voluntarily or requisitioned. This, the first of the "recovery programs," used on a small scale the procedure later followed by the Copper Recovery Corp. and Steel Recovery Corp.

Development in aluminum forging has been enormous. Eight of the large new aluminum working plants are forge shops, and in addition many copper fabricators, aircraft companies, etc., now do aluminum forging. Probably the most spectacular aluminum forging development of the year is the forging of aircraft engine cylinder heads from 90 lb. extruded aluminum slugs, announced by Wright Aeronautical Corp. The new heads are said to be 10 per cent lighter, to have 35 per cent more cooling area, and to be 100 per cent stronger than the old, sand cast heads, and to increase the power output of each cylinder 12 to 15 per cent. The slugs are forged in three steps in 1000-ton hydraulic presses. Although the new process was announced last May, the heads are not yet being produced in a big way.

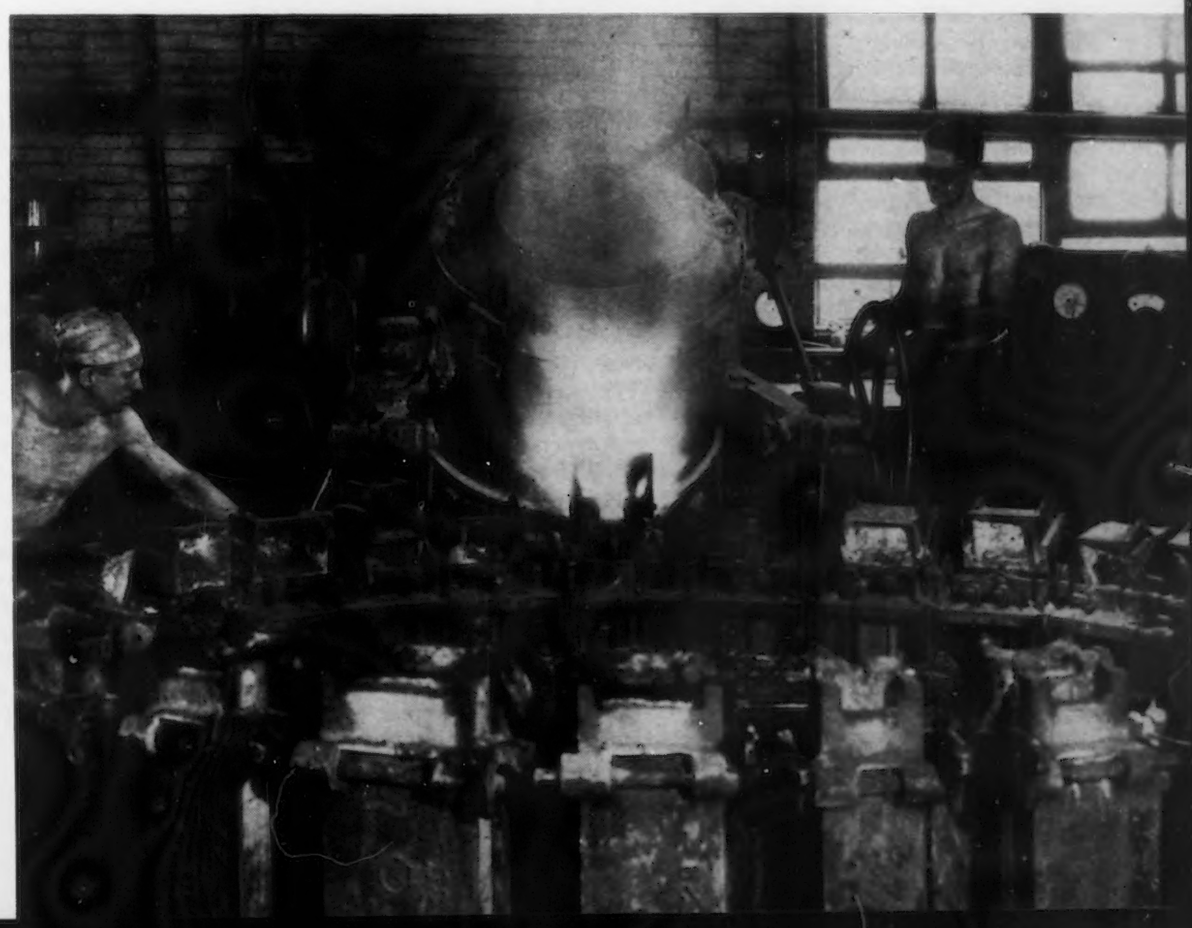
Slow and Steady:

In peacetime brass used only 7 tons of zinc for every 11 tons that went into galvanizing. Last year brass became far and away the No. 1 zinc outlet, burdening high grade zinc with the woes of shortage. And as long as the war with its voracious demand for brass continues, zinc and copper will share many of the same pressures, inseparable as a mermaid's knees.

So insatiable have been the brass mills, the stamping die makers and the die casters, that there has been no attempt to build a high grade zinc stockpile. A pile of prime western zinc exists, probably growing at an accelerated rate, but it will now begin to lose 11,000 tons a month to New Jersey Zinc's refractionation plants at Howe and Depue, Ill., where prime western is to be redistilled into high grade zinc, 99.99 per cent pure.

In June, zinc went under complete allocation, following a system of pools-for-allocations which were already swallowing as much as 75 per cent of high grade and 50 per

(CONTINUED ON PAGE 234)



War Spurs

QUITE aside from the headaches and nightmares caused by the "ship yesterday" delivery demands and the hair-splitting specifications which must be met on many ordnance contracts, the war has had the secondary effect on the foundry industry of presenting it with an excellent opportunity to prove that cast iron, for instance, is not a "brittle metal, of uncertain strength," but rather is a highly engineered material which for many applications has no practical substitute.

It may be said to the industry's credit that it is not only meeting the physical demands of the war but is also taking full advantage of this opportunity to correct the erroneous impressions of cast iron still held by some purchasing agents and design engineers. Metallurgists and engineers, working together, are meeting requirements which in the past have seemed beyond the reach of cast metals. Much of the work being done by foundry metallurgists today is shielded by censorship and full recognition of their accomplishments may not be possible until after the war. But it may be safely said that this work will have important bearing upon after the war competition and may well result in the foundry industry finding itself in a much better competitive position in the post war period than it was in the pre-war period.

Published reports of research and development work in the past year have followed somewhat conventional lines, except possibly with some greater accent on sand studies. The very effective work being done by the sand committees of the American Foundrymen's Association is contributing heavily to the advancement of founding technique. Too, the association's committees on malleable iron, on high strength iron and its newly formed division for the light metals, are developing a momentum which should have far reaching effect on the shaping of things to come after the war.

In this brief summary of some of the more interesting published reports of the past year concerning foundry technology, space does not permit touching upon all noteworthy reports. It can only highlight a few of these contributions which, it is hoped, may serve to suggest the general trend of progress in the foundry industry.

The heavy demand for large steel castings and the rather light call for gray iron products in direct war work has caused many gray iron plants to play with the idea of converting to steel. As a matter of record even at this late date there is still considerable interest in the subject.

While to the layman a foundry is a foundry, to a production man there is a great difference between cast iron and cast steel production. Typical of the problems involved in such a conversion is the need for a competent open hearth operator. Such men, according to A. W. Gregg of Whiting Corp. (*Foundry*, June, 1942.) cannot be trained in less than two to three years. And this at a time when there is already a shortage of competent personnel for existing steel foundries.

Use of an electric furnace presented similar personnel problems. However, the converter provided a possible solution for it was estimated that a converter operator can be trained in one to three months.

Aside from the melting operations, there are many other differences between the gray iron shop and the steel shop which have to be licked before conversion is successful, as for instance the cleaning room, the preparation of sand, refractories, etc. Despite these handicaps, many gray iron shops were converted to steel and did much to break a bad bottleneck.

The status of the converter in this picture was especially interesting. For many years ordnance specifications did not permit the use of converter steel and ordnance officials were slow to encourage the use of this material for war work, despite the fact that it represented about the quickest and most economical means of overcoming the steel casting shortage. A forcible argument against the extension of, say electric furnaces, to increase steel casting output was the effect this would have on the already critical electric power situation. W. A. Phair pointed out (THE IRON AGE, July 23, 1942, p. 88) that the production of a ton of castings by the converter process requires some 1000 kw-hr of electric energy less than would be demanded by an electric unit to produce the same quantity of castings.

Phair pointed out that there have been some encouraging changes in ordnance specifications looking toward greater use of converter material. There are many arguments as to why this can be safely done. For example, converter steel is being used successfully, by special permission, to meet the requirements of specifications QQS681-B-Class 4C. This specification calls for a tensile strength of 110,000 lb. per sq. in., a yield of 85,000 lb.

Foundry Research . . .

per sq. in., 18 per cent elongation to 2 in. and a 40 per cent reduction of area.

Probably one of the outstanding contributions to a better understanding of converter steel and one which may well lead to greater recognition of the qualities of this material is the study made by Sims and Dahle of the Battelle Memorial Institute entitled "Comparative Quality of Cast Steel" (ASTM preprint No. 29, June, 1942).

Sims and Dahle reported that the lack of authentic data on converter steel was one of the chief drawbacks to its wider use and their study was intended to present comparative data which would permit a sane and practical appraisal of the applicability of this metal for jobs now restricted by specifications to open hearth steel.

The bad name acquired by converter steel was earned long ago when this steel was a relatively impure and unrefined metal. Only acid converters have been used in the United States and in these units there is no sulphur or phosphorus removal. Too, lack of adequate controls often resulted in unusually high nitrogen content and steels made under such conditions were conceded to be inferior in some mechanical properties.

But under today's conditions this is changed. The modern hot-blast cupola can handle an all steel charge and a charge low in phosphorus can be selected. Some sulphur is picked up from the cupola coke, but soda ash treatment can be used to reduce this to the point desired. If a high phosphorus charge has been used, and the phosphorus content is too high, it can be brought down after blowing by ladle treatment with a basic oxidizing slag. Such a procedure has only recently been perfected but is proving quite successful (one of these processes, the Yocum process, was described in THE IRON AGE, Oct. 31, 1940, p. 52). Control of the composition charged to the converter and control of the blowing operation can be provided by the photoelectric cell, another recent development, which serves to keep nitrogen content of the blown metal to a minimum.

. . . Under lash of war-time demands, foundrymen improve control of moisture in blast air, develop use of tinless bronzes, perfect thermal method for reclaiming used core sand and put atmospheric pressure to work producing better castings. Converter steel is taken from the doghouse as new studies show that with proper deoxidation and employment of newly developed controls such steel is fully adequate for war purposes.

° ° °

Sims and Dahle tested specimens from heats of acid open hearth, basic open hearth, acid electric, basic electric, triplex and side-blown converter steel. The chemical analysis of all the steels came under the grade B classification. Discussing the analyses of the various samples, it was pointed out that the basic open hearth steels as a class were slightly higher in phosphorus than the acid open hearth and electric types. The triplex steels had the highest nitrogen content, with an average of about 0.011 per cent. The straight converter and acid electric steels were in the range of 0.006 to 0.01 per cent nitrogen, while the open hearth steels had a lower range of 0.004 to 0.006 per cent.

Table I is a summary of the mechanical properties of these steels, while Table II lists fatigue properties.

Summing up the results of their investigation, Sims and Dahle reported that except for the lower phosphorus content of the basic open hearth specimens, it would be difficult to determine by analysis alone by what process the various specimens had been made.

The microstrucure of the samples appeared to be governed by deoxidation practice, both as to inclusion type and grain size. The room temperature mechanical properties were quite orthodox for grade B cast steel and varied with the composition and type of inclusions, without regard for method of manufacture.

The converter steels as a group, had the best low-temperature notched bar impact properties, but this was held to be a result of deoxidation with aluminum rather than melting practice. A limited number of standard fatigue tests showed a superiority in endurance ratio for the acid-open hearth and acid electric steels, but notched fatigue tests showed a notable similarity for all steels.

No evidence was found to favor one process over another, except

that the basic open hearth gave better phosphorus control. Mechanical or engineering properties of all the steels were governed by composition and deoxidation practice rather than by the melting method.

For example, acid electric cast steel not having had an adequate aluminum addition showed low-temperature impact shortcomings, just as converter steel would without an adequate aluminum treatment. When low-temperature shock resistance is needed, it would be in order to impose a low-temperature notched-bar impact acceptance test. If this be done and a steel passed or rejected on performance rather than on the melting process used, some steels now being accepted but not of good low-temperature toughness would be excluded and much good converter steel would be made available.

The most significant statement of these two eminent investigators was that "with proper deoxidation, all the process can make steel of the quality demanded for war purposes."

The triplex method (THE IRON AGE, May 7, 1942, p. 61) for producing steel castings, mentioned in Sims and Dahle report, is a relatively new process but appears to hold promise as a method for making quality castings with lower carbon than is obtainable from a cupola alone. The triplex method derives its name from the fact that it involves the use of cupola, converter and electric furnace. (See Fig. 1.)

Aside from the possibility of producing low carbon castings, the triplex method also provides a means of assuring a continuous supply of molten metal for the pouring lines, an advantage not previously available to steel foundries. Too, it provides an economical and quick means of extending electric furnace capacity, for in the triplex process the electric furnace is charged with hot metal and hence acts largely as a holding medium and a spot for making final adjustments to composition. Use of the electric unit in this fashion obviously reduces the power demand per ton of castings. A number of triplex installations have been made over the past year. One of these projects, that of the Ford Motor Co. at Detroit, will be described shortly in an article in THE IRON AGE.

When using the triplex method, the customary practice is to make up a cupola charge of steel scrap, plus silicon bearing material, such as 50 per cent ferrosilicon, silicon briquettes or silvery iron. The temperature of the converter steel is controlled by the percentage of silicon in the cupola metal. With 2 per cent silicon in the cupola metal, the converter metal will have a temperature of 3000 deg. F. or more.

The metal from the cupola is desulphurized in the ladle prior to blowing. With proper procedures sulphur can be held in a range of 0.25 to 0.04 per cent. Ordinarily, steel is deoxidized by additions of ferromanganese, ferro silicon and aluminum before delivery to the electric furnace, which in this case acts as a holding unit.

The composition and temperature of the metal is usually finally adjusted in the electric furnace and if alloys are to be added they are usually added there. At the time the article was written, converter steel had not been approved for

TABLE I
Mechanical Properties of Grade "B" Cast Steels

NOTE.—Tensile values and Charpy impact values are averages of duplicate tests. Izod values are averages of three tests.

Steel	Yield Strength, psi.		Tensile Strength, psi.		Elongation, per cent		Reduction of Area, per cent		Brinell Hardness As Normalized and Drawn	Impact Strength As Normalized and Drawn, ft-lb.		A.S.T.M. Grain Size Normalized and Drawn	Type of Sulfide Inclusions
	As Normalized	As Normalized and Drawn	As Normalized	As Normalized and Drawn	As Normalized	As Normalized and Drawn	As Normalized	As Normalized and Drawn		Izod	Charpy		
ACID OPEN HEARTH STEELS													
493	49 000	46 500	74 500	74 500	33.5	32.0	57.0	55.5	147	34	25	7 to 8	I
509	46 000	43 000	75 000	75 000	33.0	34.0	57.0	56.5	142	32	24	7 to 8	I
F-1	46 500	46 000	84 000	83 000	28.0	29.0	47.0	46.5	162	22	18	6 to 7	I
F-2	49 000	47 500	86 500	87 000	29.5	29.0	49.5	49.5	169	22	18	6 to 7	I
BASIC OPEN HEARTH STEELS													
9551	45 000	45 500	74 000	75 500	29.0	33.0	38.0	56.5	144	40	27	6 to 7	I
9567	46 000	46 000	78 000	79 500	31.5	32.5	56.5	57.0	150	36	26	7	I
O-1	48 500	46 500	82 500	81 500	31.0	31.5	52.5	52.5	162	34	22.5	7	I
O-2	47 500	48 000	80 000	80 500	32.0	33.0	53.5	55.5	157	29	24	6 to 7	I
ACID ELECTRIC STEELS													
715	56 000	48 000	83 000	81 000	28.5	28.5	49.0	49.5	165	28	20	8	I
724	52 500	47 500	80 000	80 000	30.5	30.0	54.0	54.0	157	29	23	8	I
1009	50 500	49 000	82 500	82 000	29.0	30.0	53.0	52.0	162	25	20	7	I
1025	47 000	47 000	78 500	78 500	32.0	30.5	53.0	54.5	155	27	21.5	7	I
1163	47 000	46 000	75 000	75 000	27.0	29.0	40.0	45.0	142	....	22	7 to 8	III
BASIC ELECTRIC STEELS													
E-1	59 000	60 500	92 000	93 500	20.0	23.0	26.5	33.0	188	19	12	7 to 8	II
CONVERTER-ACID ELECTRIC STEELS (TRIPLEX)													
H-30	58 500	53 500	84 500	87 000	28.0	26.0	44.5	35.5	170	34	19	8	III
H-34	58 000	55 500	87 500	87 500	25.5	24.5	35.0	37.0	174	33	18.5	8	III
H-38	47 500	47 500	81 000	81 000	20.0	24.0	29.0	33.5	157	27	15	6 to 8	III
H-42	61 000	55 500	90 000	91 500	23.0	23.5	32.0	30.0	176	21	13	8+	III
CONVERTER STEELS													
1	53 000	53 500	80 500	81 000	29.5	31.0	45.0	49.5	155	38	21	8	III
2	47 500	46 000	74 500	75 000	28.0	33.0	42.5	55.5	146	44	28	8	III
3	48 500	48 000	76 500	77 500	27.0	31.0	44.5	53.0	152	42	26	7 to 8	III
4	47 000	47 000	72 500	73 500	29.0	31.0	47.0	50.0	143	43	25.5	8	III
A	46 000	44 500	77 000	76 500	28.0	31.5	40.5	52.0	148	28	23	7	III
B	59 500	58 500	87 500	88 000	19.0	24.0	22.5	34.5	172	26	13	8	II
C	55 500	55 000	85 500	85 000	22.5	23.5	32.0	31.0	168	30	13	8	II
D	52 000	50 000	81 000	80 000	27.0	30.0	47.0	48.5	157	39	23.5	7 to 8	III

TABLE II
Fatigue Properties of Grade "B" Cast Steels

Steel	Endurance Limit of Steels, psi.[a]			Endurance Ratio, Endurance Limit/Tensile Strength		
	Unnotched at Room Temperature	Notched at Room Temperature	Notched at −40F.	Unnotched at Room Temperature	Notched at Room Temperature	Notched at −40F.
Acid open hearth steel No. 493	38 000	22 000	....	51	29.5	....
Basic open hearth steel No. 9551	35 000	22 000	....	46	29.0	....
Acid electric steel No. 724	40 000	25 000	24 000	50	31.0	30.0
Basic electric steel No. E-1	40 000	27 000	....	43	29.0	....
Triplex steel No. H-30	34 500	26 000	....	40	30.0	....
Converter steel No. 3	33 000	24 000	22 000	43	31.0	28.5

[a] Kommers square notch specimens used at room temperature and at −40 F.

ordnance work under specification QQS-681-b, although several foundries have been making castings under a more difficult specification, No. QQS-681-a. The triplex method, however, has been approved for production of all types of ordnance castings.

Typical physical properties of triplex castings may be taken as follows: Tensile, 80,000 to 85,000 lb. per sq. in.; yield, 43,000 to 48,000 lb. per sq. in.; elongation in 2 in., 25 to 30 per cent; reduction in area 42.5 to 52.5 per cent; cold bend, 140 to 180 deg.

There are several variations to the triplex method. If a converter is installed in connection with basic-lined electric furnaces, it is possible to use practically any kind of charging material, even cast iron. The cupola metal would then be desulphurized in the ladle prior to blowing and the blown metal would be dephosphorized in the basic electric furnace. This would make available high phosphorus material which at present is not usable by any acid-steel making process.

Another, and perhaps more promising method, involves the use of the dephosphorizing method developed by Gordon Yocom (THE IRON AGE, Oct. 31, 1940, p. 52). With this method converter steel, after blowing, is dephosphorized in the ladle by treatment with a combination of lime, fluorspar and mill scale. In this way removal of any desired amount of phosphorus, up to 70 per cent, is readily accomplished. The metal, after this treatment, is in a highly oxidized condition and requires treatment in the electric furnace to remove excess oxygen.

If the Yocom method is adopted for phosphorus removal and the metal transferred to a basic electric furnace, it is possible to operate with a single slag, wherein sulphur will be removed, making it unnecessary to desulphurize the cupola metal prior to the converter operation.

Another phase of casting production which received considerable impetus from the war and which will undoubtedly have an important influence on after the war competition is that of controlling the moisture in cupola blast by the use of air conditioning units.

All foundrymen are aware of the influence of moisture in the air, as on a rainy day, on combustion in the cupola. Excessive moisture in the air is usually compensated for by empirically increasing the coke charges. In addition to being uneconomical, such a procedure does not effect the additional hydrogen contained in moist air which, if it enters the iron, may have various affects upon the resulting metal. This "secondary" effect of excessive hydrogen content can have very serious consequence on several qualities of the iron, according to R. J. Cowan of Surface Combustion Co. (THE IRON AGE, Nov. 12, p. 43, and Nov. 19, p. 46, 1942). This consideration of the effect of hydrogen, as a consequence of excessive moisture in the blast, is something of a new angle and is one that adds much weight to the argument for use of mechanical devices for removing moisture from the blast before it enters the furnace.

This "before" is stressed because the moisture present in the blast has an altogether different effect upon the iron (so far as hydrogen is concerned) than moisture which may be present in the form of damp coke.

In the latter case the moisture enters the cupola at the charging door and is largely driven off at low temperatures with the top gases while the charge is being heated.

On the other hand, moisture entering through the tuyeres is in an ideal form and at an ideal spot for adding hydrogen to the molten metal.

To illustrate the effect of moisture on the chemical analysis of gray iron, Cowan cites an experiment in which iron was run in a cupola in which all conditions were kept constant, except the moisture content of the blast. The analyses resulting from this variation of moisture were as follows:

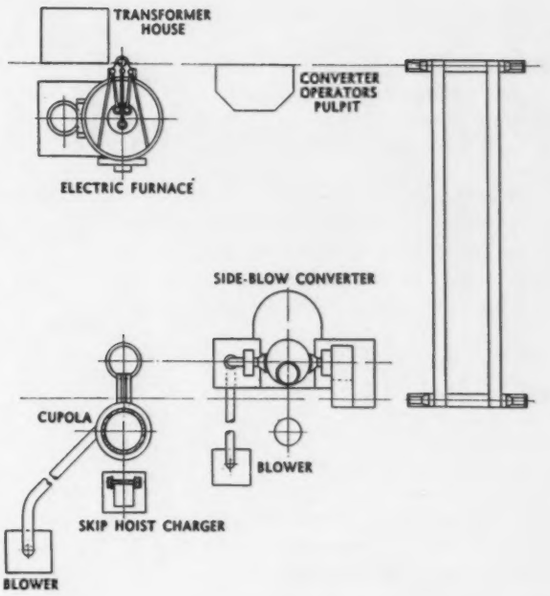


FIG. 1—Typical layout for a triplex melting installation.

Heat No.	17	18	28
Grains of moisture, per cu. ft.	21.2	10.4	1.5
Total carbon	2.64	2.92	2.99
Combined carbon	0.95	0.82	0.71
Mn	0.70	0.83	0.79
P	0.136	0.144	0.122
S	0.163	0.162	0.144
Si	1.42	1.58	1.77

These analyses were taken to indicate that as the moisture content increases, the total carbon content and the silicon decreases, but the combined carbon increases considerably. This would suggest that the iron increases in hardness as the moisture increases. Test specimens from the three heats listed above were cast and showed that the chill depth was increased, by actual measurement, from 0.75 in. to 1.5 in. from the low to the high moisture content.

As practical proof of this evidence, Cowan cited the case of a piston ring maker who found that the rings became white and hard when the moisture content of the blast exceeded a certain minimum.

The cast iron specimens mentioned previously were further analyzed for hydrogen content with the following results: The specimen containing 1.49 grains of moisture showed 0.00004 per cent hydrogen; the specimen with 10.4 grains showed 0.00009 per cent hydrogen; the

specimen with 21.2 grains showed 0.00018 per cent hydrogen.

While these hydrogen values appear rather small, it is pointed out that they represent a weight basis of a very light gas in a heavy metal. On the basis of comparable volumes, an entirely different picture is obtained. For example, a hydrogen content of 0.0008 per cent on a weight basis is equal to slightly more than 1 cu. ft. of hydrogen per cu. ft. of iron.

The effect of hydrogen is so far reaching that characteristics derived from excessive hydrogen will persist even through subsequent heat treatment. For example, even though the metal used in producing malleable castings be duplexed after the original melting operation, the effects of excessive hydrogen in the original metal will carry through, resulting in an increased number of cracked castings. There is also evidence that hydrogen retards the rate of annealing of malleable iron. Small percentages of hydrogen are reported to prolong the annealing period a matter of days.

Among the other effects of hydrogen noted by Cowan are a retardation of graphitization and an increase in depth of chill in cast iron. It also causes brittleness, low elongation and small reduction of area in specimens.

In an effort to counteract the variations in melting operations due to changes in the moisture content of the blast, some cupola operators had adopted the practice of adding moisture to the air to provide saturation at all times and in this manner level out the fluctuations incident to the weather. This practice, however, loses sight of the fact that moisture in the air adds hydrogen to the metal. Fig. 2 shows amount of coke which must be added to a base charge to compensate for a given increase in moisture content of the blast. This graph was prepared by the Battelle Memorial Institute.

Ignoring the effect of hydrogen, it is possible to establish a method of adjusting coke charges to compensate for the variations in the moisture content of the air and thus obtain the desired melting temperatures in the cupola. This method is obviously subject to the unavoidable human error and is equally uneconomical.

Cowan makes the point that the use of an air conditioning unit to adjust the moisture content of the blast, before it enters the cupola, not only assures the lowest practical hydrogen content but also provides economies in fuel consumption. There are, of course, many secondary considerations to this matter of balancing combustion conditions in the furnace, many of which have important bearings on the physical characteristics of the metal. These effects, however, are evident to any foundrymen from the viewpoint of ordinary good melting practice, regardless of how it might be obtained.

In the light of possible exigencies of war time operations, a recent English study of the use of fuels other than fuel oil in melting furnaces for light alloy foundries contains much that may be of interest in this oil-rationed nation. The report was prepared by the Light Metal Founders' Association (*Foundry Trade Journal*, Oct. 22, 1942).

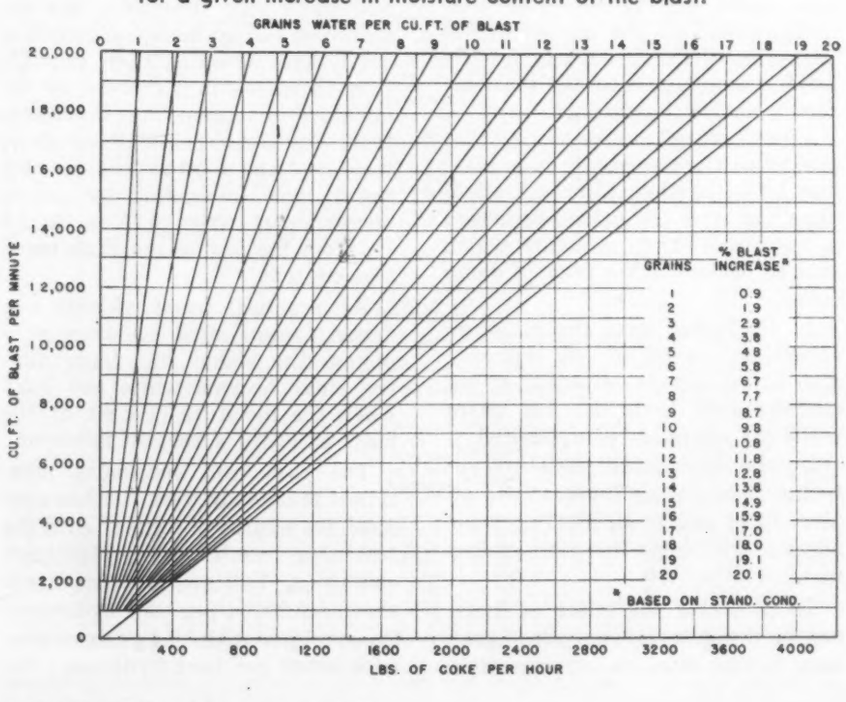
Concerning reverberatory open-hearth furnaces with capacities of one ton and greater, the report said that while they are usually fired by hand with coke, they can also be fired with coal. In the latter case, firing can be by automatic underfed stokers which give better control of combustion and temperature. Coke firing, if dry coke is used, gives satisfactory results, so far as the condition of the metal is concerned. Doubt was expressed as to the danger of hydrogen pick-up if coal is used, but in the absence of authentic data this is by no means certain.

Small reverberatory furnaces of the barrel type can be fired by oil, commercial gas, producer gas or creosote or pitch. Large crucible or pot furnaces, whether tilting or stationary, may be fired by the same fuel and, in addition, probably also with pulverized coal. Tests are currently being conducted with this latter fuel which should establish its qualities for this type of firing.

Die shop furnaces used for maintaining can be fired by oil, commercial gas, or producer gas, and possibly by pulverized coal. It is understood that furnaces with a minimum rate of oil consumption of 1 gal. per hr. are liable to run into difficulty using creosote or pitch. A new design of die shop furnace was reported with a single pot using raw coal fired by means of an underfed stoker.

With respect to the conversion of existing installations to use fuel other than oil or commercial gas, it was reported that large crucibles or pot furnaces can be changed over without modification, except slight alteration to the burner valve, to use creosote and/or pitch. Producer gas may also be used, but this

FIG. 2—Effect of moisture on coke consumption. This chart shows the amount of coke which must be added to a base charge to compensate for a given increase in moisture content of the blast.



would probably require some modification of the furnace either by increased combustion space or by the addition of a recuperator, or both. It is probable that pulverized coal could also be used with economical results.

Medium crucibles and pot furnaces can be converted to creosote and/or pitch or producer gas by modifying the burner and burner valve. Using producer gas, it may be found that melting time will be increased slightly, but this can be counteracted by using an iron pot instead of a crucible or by the addition of a recuperator, or both.

Die shop furnaces used for maintaining can be changed over without modification, except to the burner, direct to producer gas. The use of creosote and/or pitch is not recommended for furnaces with a consumption of less than about 1 gal. per hr. The report stresses that most of these conversions require quite a capital outlay and will take time to complete.

As a precaution against unexpectedly being forced to convert, which might result in lost furnace time during the conversion, the report recommends providing emergency standby equipment in the form of furnaces of the crucible or pot types suitable for firing with coke. Furnaces of the pot type may be cheaply constructed and kept in readiness for use in an emergency. Certain types of self-contained portable units are available which can be placed anywhere and require only a connection to a power source.

The report recommended the purchase of several such units as an inexpensive means of guarding against emergency stoppage.

While on the subject of furnaces, improved types of low-frequency and high-frequency furnaces was reported by H. Beissner of Germany (*Die Giesserei*, Vol. 28, June 13, 1941). A disadvantage of the low-frequency furnace has been, Beissner said, the high temperature difference between the iron in the submerged channel and the metal in the bath. This limited the current which could be fed to the furnace and necessitated frequent relining of the channel.

In the improved low-frequency furnace, the channel is made very much wider so that a 3-ton furnace can be fed at 700 to 800 Kw. and the whole charge can be superheated by 200 deg. C. (392 deg. F.) in less than 30 min. Or, three tons of cold metal charged into molten metal in the bottom can be melted down in under 2 hr. In the improved furnace, the lining of the channel is expected to last for 1000 melts.

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CAST steel hull for a Canadian tank. This company was one of the first to fabricate cast tanks.

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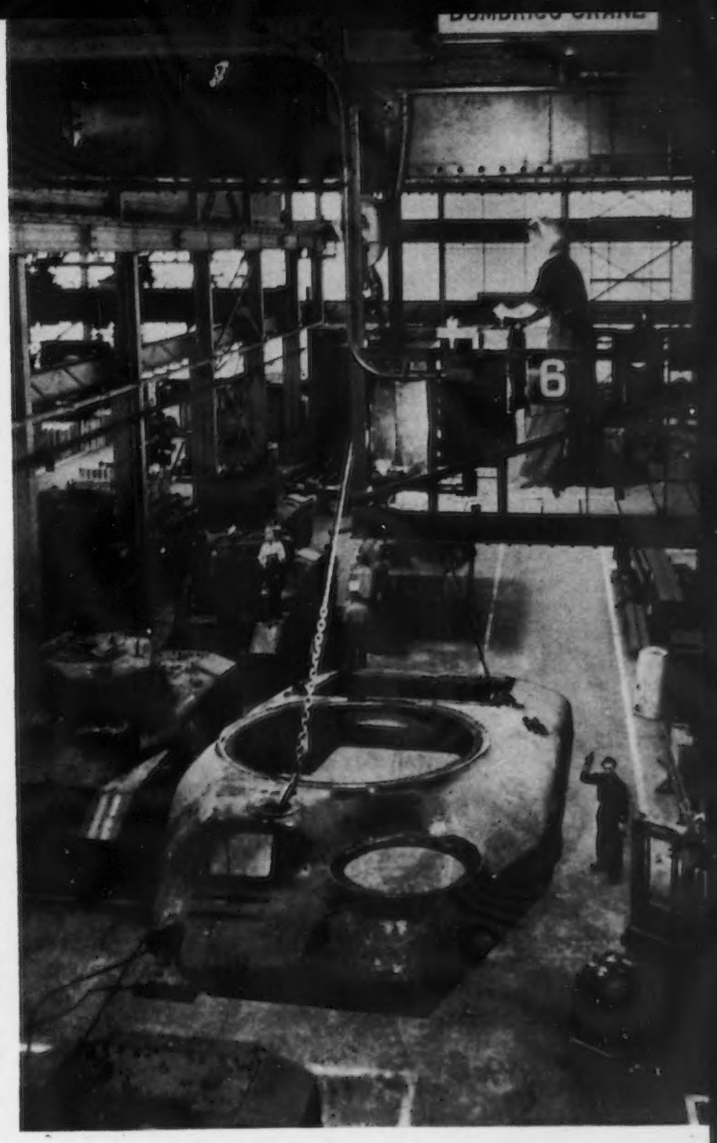


The improvements to the high-frequency furnace consists of designing it with a tap hole, instead of tilting. This not only eliminates the tipping mechanism, but also the magnetic screening which was necessary for it. This cheapens the cost of the foundation, saves the cost of frequent relining of the spout and lowers current consumption by some 10 per cent, according to Beissner.

Shortages of important alloying materials caused by the war have forced the use of substitutes for tin in various types of bronzes. Aluminum, a reasonable substitute for tin in such work, is ruled out by its tightness. The problem of developing substitutes in bearing bronzes is made especially difficult by the fact that tin is almost unique in the low coefficient of gliding friction which it imparts to such materials. The only true substitute in this respect could be indium, but the cost of indium is so high as to put it beyond this use.

On the other hand, the tin substitution problem for red brass, valve bronze and gunmetal is not so difficult. The most promising substitutes for this use are antimony and silicon, both of which have been studied before and consequently a good bit known about their behavior.

Antimony bronzes, running about 7 per cent antimony have proved to fit into the picture fairly well for some uses, if properly cast and annealed. Their elongation is low, usually a few per cent in 2 in., but their hardness is higher than gun metal and strength is about equal to brass.

More likely as general substitutes, however, are the silicon bronzes. A number of highly developed proprietary types of silicon bronzes are already available, but chief interest appears to center on Everdur, PMG metal and Tombasil. While these three metals come under the general description of silicon bronzes, they nevertheless do have some individual characteristics as have been described by M. G. Corson (THE IRON AGE, Jan. 29, 1942, p. 46).

Corson's report concerned only Everdur, running 4 per cent sili-

(CONTINUED ON PAGE 246)

Detroit, Like

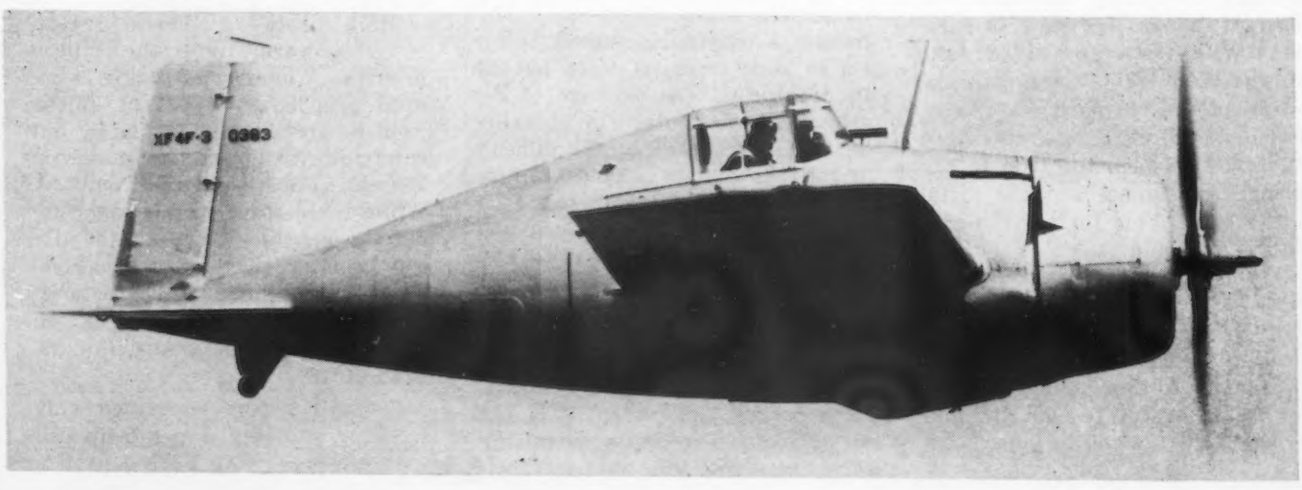
IN THE past 12 months the automobile industry has all but ceased to exist. An armament industry has sprung up in its place. The story of that transformation was the big news out of Detroit during 1942—a metamorphosis which changed machine processes and developed new ones, enlarged worker skills, radically revised end products, and brought production in Detroit and its environs throughout the middle west to the highest level of its always remarkable history.

In retrospect it is almost impossible to believe that only a short 12 months ago the topic of conversation in Detroit was whether reductions in passenger car and civilian truck manufacturing would be carried much farther. The extent of the vast turn then immediately ahead from peace to war goods was hardly realized, even with Pearl Harbor and the Jap march down to Singapore still in the headlines. The story of the 12 months was the same story which Winston Churchill can tell today for the progress of United Nations arms: The auto industry's war program is not necessarily at the beginning of the end, but it is certainly beyond the end of the beginning.

For 1942 in Detroit (and by Detroit is meant what used to be the automobile industry) has been a year of upheaval, an astounding year in every particular. Late February and March marked the bottom point of turn—employment lows, production lows, anticipation lows. From that point on the upbuilding process began. Those were the months when tooling was rushed at an historic pace, when plants were turned inside out and additions were built next door to them to enlarge capacity to undreamed levels. By the end of summer the fruit of that vast tooling and preparatory program began to be manifested. The first tricklings of mass production eddied forth from scores of plants. Today, at the start of a new year, those production trickles have swelled toward floodtide level. Ahead in the next 12 months is a constantly accelerating projection toward the highest manufacturing levels in history. Already the pace of output has caught up with the pace of new incoming orders, but a tremendous bulk of deliveries remains to be made before our battlefronts are mechanized to the extent our generals and admirals would like to see.

The place of the erstwhile automotive industry in the war effort cannot be underestimated. Total war goods expenditures during 1942 were around $47,000,000,000; roughly a tenth of these outlays were to the automotive plants for delivered goods. Of 17,500,000 employed in war work, nearly a million today are in the war plants. The industry is producing all of the trucks, most of the tanks, most of the machine guns and a large

THE newly formed Eastern Aircraft Division of General Motors Corporation, embodying five former automotive plants on the Atlantic Coast, is engaged in the production of two types of fighter craft for the Navy. One of these, a Grumman design, is shown here.



a Phenix...

By S. H. BRAMS
Detroit Editor, THE IRON AGE

THE production record of the automobile industry since Pearl Harbor can be described graphically and easily in the following terms:

Automotive plants have delivered aircraft fuselage sections, engines, propellers and parts equal in dollar volume to 50 squadrons of war planes each consisting of 15 heavy bombers and 30 medium bombers and 90 fighters.

Tanks, military vehicles and parts produced by automotive companies equal the cost of equipping 57 armored divisions with their balanced complements of 3,314 motorized vehicles each.

Seventy submarines and 650 motor torpedo boats could be purchased with the amount of money equivalent to the year's automotive output of marine equipment.

Added to this are millions of dollars of guns and ammunition, range finders, pontoons, helmets and hundreds of other armaments being produced by the automotive industry.

—From a summary by the Automotive Council for War Production

proportion of the anti-aircraft guns, close to half of the aircraft engines, and most substantial proportions of shells and ammunition, smaller marine motors, electrical equipment and miscellaneous needs.

In its tremendous march forward, the automobile industry has multiplied the amount of its productive space. There are no exact figures available and exact figures would be censorable, but it is safe to estimate that around 20,000,000 sq. ft. of new floor space was added to plants during the past 12 months by the automobile industry. A large share of this fabulous increase is concentrated in several new factories which rank among the largest in the country. The Ford Willow Run operation is the best known of these, but its standing in the size rankings is challenged by such operations as the Dodge-Chicago aircraft engine plant, the Allison aircraft engine plant at Indianapolis, and at least one other establishment. Probably an equal amount of previously employed space was converted to war work by automotive concerns.

Equipping of these plants which have been set up for war work represents an investment of hundreds of millions of dollars—almost all by the Defense Plant Corp., but a fair share by private investment, the latter portion of which will immediately be available to the individual corporate owners for peacetime uses when the war comes to its end.

The oncoming year will see little new plant space developed. Existing roofs will have to house facilities. And tooling requirements which were at peak levels last summer are already thinned out, in the wake of big programs brought toward completion during the late 1942 months. It is felt in Detroit that even though the tool and die industry is a good way past its period of greatest activity of all time, one tool bottleneck remains as the turn is made into 1943, one that is getting worse—the scarcity of cutting tools. Hopes for early relief in this direction are befogged by the fact that as production increases, the need for cutting tools will also advance, and supply is already lagging behind demand.

As the turn is made into the new year, automotive industry employment is at its highest level in history, and will rise still farther. Today's level reflects a steady climb from the low point of last February.

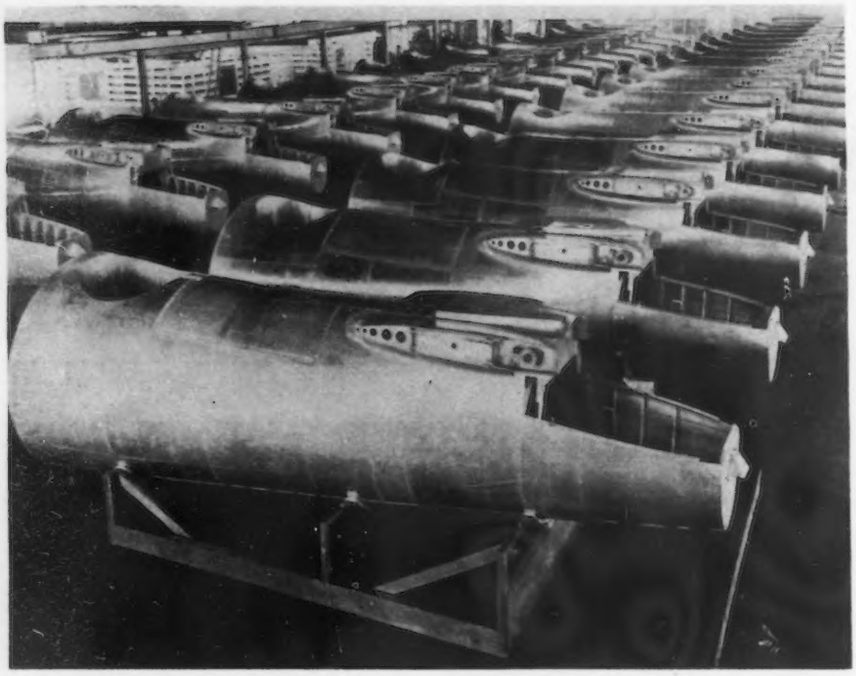
A year ago at this time employment in the plants of the automobile and truck producers came to approximately 437,000 men and women. This total had already fallen approximately 77,000 from the levels of the preceding June, when car and truck output was at record high levels. Today is stands at 615,000.

In March, when passenger car production was cut off entirely, the total plummeted down to approximately 402,000. Then began the steady climb toward today's figure.

It probably should be noted here for the sake of the record that General Motors employment today totals about 360,000 men and women, the highest by far in that company's long history.

This is the record of passenger car and truck producers themselves. But they represent only two-thirds or so of the total employment of what is regarded as the automotive industry—the 1000-odd plants whose main function is to supply the industry with its sub-assembly and parts requirements. Figures indicate that the aggregate of employment in all automotive plants runs approximately 950,000 today, compared with 620,000 at the low point last February. And it is estimated that toward the end of this year, this overall volume of employment will have risen to definitely greater heights, contingent on the amount of curtailments which may develop out of materials tightness and changing war strategy.

One development of note manifested itself during 1942 which will be accentuated during 1943. The proportion of women in the automobile plants was always small until last fall when manpower shortages began to make themselves felt, particularly in metropolitan



A CONSTANT stream of medium bomber rear fuselage sections flows in mass production at the Hudson Motor Car Co.'s airframe plant in Detroit. This line of completed sections going through final inspection extends beyond camera range. Sections are shipped to a central assembly point, tested and flown to the battle fronts.

sections where draft requirements were becoming constantly more noticeable. It could be estimated that a year ago the proportion of women in automobile industry plants was about five per cent. Today it has risen to approximately 20 per cent. It can be figured that by late 1943 the total will be up to approximately 30 per cent. These women are doing a wide variety of tasks, performing with distinction in virtually all phases of manufacture except those involving the handling of heavy sections, as in the tank plants. Manufacturing executives had anticipated the female invasion with mixed apprehensions, but their fears proved to have little foundation in fact.

As women came into the plants spoilage rates increased somewhat and speed of output slowed down, but after orientation periods ended spoilage reduced importantly, below the level customary for men workers in many plants, and it was not at all uncommon to find production speed advanced.

The one fault to be found with women after they had adjusted themselves completely to their new jobs was a somewhat higher degree of absenteeism than was customary among the men. Factory officials attributed this to the problems of housekeeping which evidently continue to be an important consideration on the minds of their female help. Interpretation placed on sporadic absenteeism is simply that housework is put aside by women workers until it has to be done, whereupon they take a day or two off to straighten up their personal affairs before coming back to their jobs.

Absenteeism among men, incidentically, was a quietly increasing problem during 1942, apparently an outgrowth of the steady and long periods of overtime. Especially was this noticeable on Mondays. The unvarnished situation seems to be that weekend sprees culminate in hangovers which keep workers away from their machines when the new work-week begins.

If working hours are shortened in 1943, as appears quite possible in a large number of plants, it would be reasonable to expect that absenteeism would decline, for workers will then feel less free financially to take time off as they might desire.

The year just gone by was a quiet one in the field of labor relations. Pearl Harbor soon brought a pledge of "no strikes for the duration" from the CIO United Automobile Workers union. As a result not a single strike was authorized during 1942, and although there were "unauthorized" and "wildcat" walkouts aplenty during the past year none of them were really serious, as measured by pre-1942 standards.

The small independent unions, such as the Mechanics Educational Society of America, the Society of Tool and Die Craftmen and others in the Detroit area did not follow the UAW's lead, of a no-strike pledge, but they held fairly well in line. The nearest thing to a serious walk-out occurred late in the fall when the MESA called its men out in 15 Detroit shops, to force action by the War Labor Board in a jurisdictional squabble among maintenance men at a Briggs Mfg. Co. plant in Detroit. This tie-up lasted through one Saturday.

The outlook continues for 1943 as it was in 1942—no strikes of any consequence but perhaps an increasing number of intermittent short-lived walkouts. Whether the headquarters of the various unions are unable to control their men and prevent them from walking out as the impulse seizes them, or whether these "unauthorized" strikes are actually led from headquarters is of no matter—the fact is that the men do walk out from time to time and that there seems to be little which can be done to prevent it. It would be reasonable to expect more and more of this sort of thing as time goes on and the original vivid memories of Pearl Harbor become somewhat dulled by the passage of time.

As the turn is made into the new year, wage rates have risen to the highest levels in history. Latest figures for Michigan industry show that durable goods plants are paying between $50 and $55 a week to their men, based on averages around $1.15 an hour, with work schedules running around 45 hours a week, the last five hours of which are at time and a half overtime rates.

Whether wages will continue at this all-time high level during 1943 is a question. Hourly rates quite possibly will edge a little higher—they are scaled to the cost of living and the cost of living is creeping steadily upward, despite the good intentions of the Office of Price Administration in this respect. As the price level goes up, so will the hourly cost of labor. But at the same time, the need will be diminishing for overtime hours. Cutbacks in schedules can be expected to turn up with more and more frequent regularity as all producers reach

high gear in their output schedules and as the needs of war shift sharply with the turns of fortune on the battlefield. Also to be considered as a factor tending to reduce hours is the unstable supply of basic metals and of cutting tools, two headaches of planning departments which aspirins cannot cure. These facts will tend to eliminate the overtime pay totals in effect in many plants and will probably more than neutralize any hourly rate gains which may be achieved by the men and their bargaining committees.

Against the panorama of war production, only vestiges of truly automotive output remain. A small amount of parts manufacturing has been going forth during 1942, limited to the minute quantities permitted by the War Production Board. And these parts are all of the functional variety, mainly engine components. The output of fenders and other sheet metal parts was completely eliminated by early summer except in isolated and sporradic cases where materials had already been semi-fabricated or were otherwise impossible to convert to new uses.

It appears now that 1943 will see a further diminution of parts manufacturing, with production geared solely to meet primary requirements for the continuation of transport throughout the country.

With the end of automobile output, the scrapping of dies, tools and fixtures was accelerated. As of today all companies have scrapped production equipment for models older than 1938, throwing into the discard the custom of holding this equipment for as much as 10 years in some cases to meet contingencies which might arise.

The scrapping of outdated equipment has furnished the nation's scrap pile with many million pounds of cast iron, alloy and carbon steel, and non-ferrous metals.

It can be expected that 1943 will see this tool, die and fixture scrapping program accelerated, quite possibly to the point where nothing will be left but actual 1942 model production equipment. It is doubtful that this equipment will be scrapped at any time during the war inasmuch as its existence is deemed necessary, both by industry officials and by government heads, to assure as rapid a return as possible to normal civilian production processes when the war ends.

Coincident with the stopping of civilian production, planning for future models has all but ended. Research, experimental and engineering laboratories which ordinarily were working two, three and four years ahead on automobile development have been turned over to the war effort. Such work as may have been undertaken in 1942 and may be undertaken in 1943 is completely on the casual side, not part of a broad plan but rather particularized developments, small in scope and undertaken mainly by researchers whose particular talents do not fit them into war work.

At the same time, it must be reported that the automobile industry buzzed intermittently during 1942 with reports that some aviation producers are contemplating an entry into the passenger car field when the war ends. To support this conclusion it is pointed out that the aircraft companies have built up tremendous productive plants to meet mushrooming armament demand, but will need only fractions of these facilities

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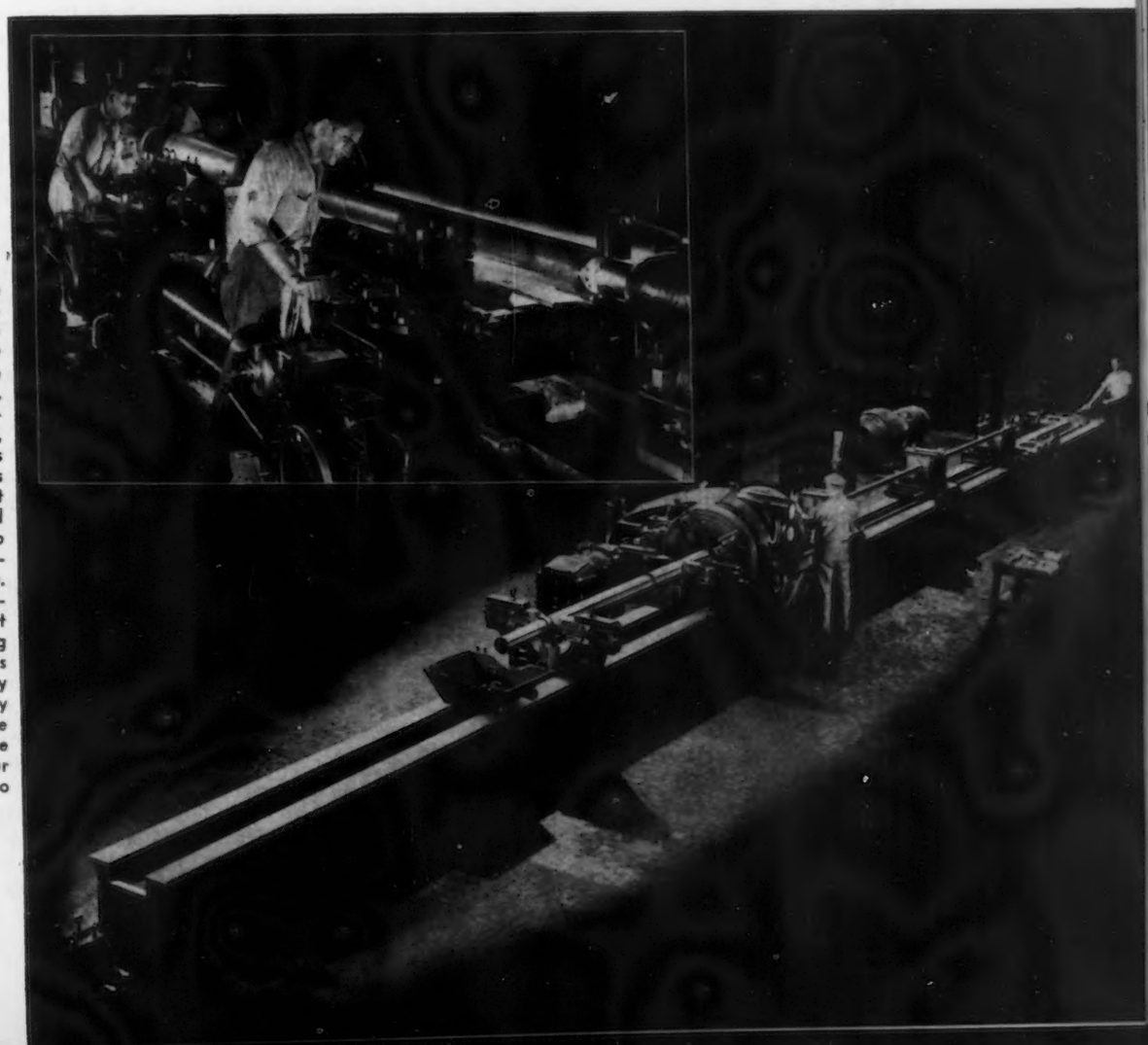

THIS hollow spindle gun boring lathe, one of the largest in the country, is employed by Chevrolet to machine 90 mm. gun barrels. Built by Fairbairn, Lawson, Comb, Barbour, Ltd., of England, it has a 64 ft. bed. Gun tubes are provided Chevrolet by a U. S. Arsenal, and are then subjected to 354 machining operations before finishing. The 90 mm. guns, originally anti-aircraft weapons, are coming into new prominence as anti-tank weapons. They have been built by Chevrolet on a volume basis, indicating the diversified range of war contracts assigned to that producer.

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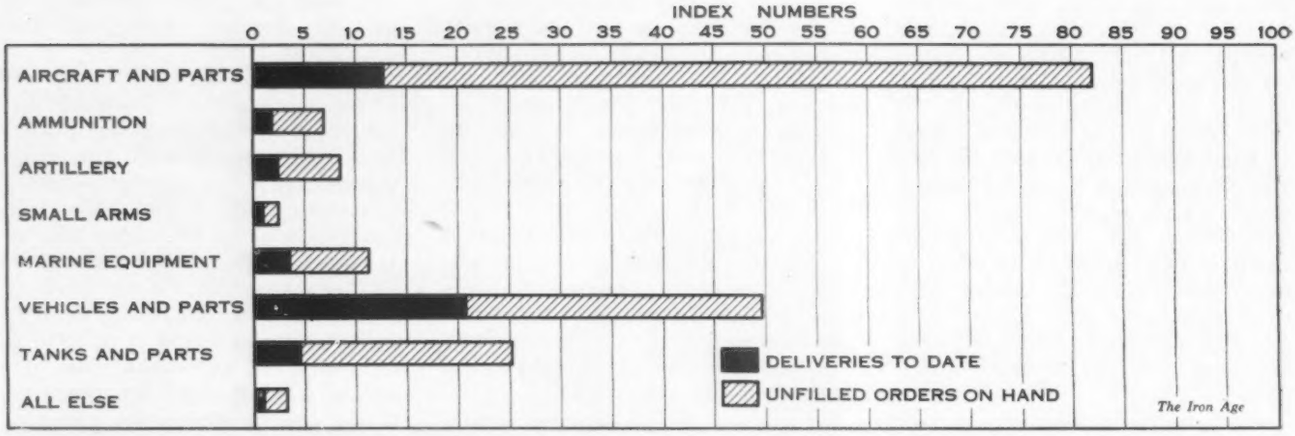


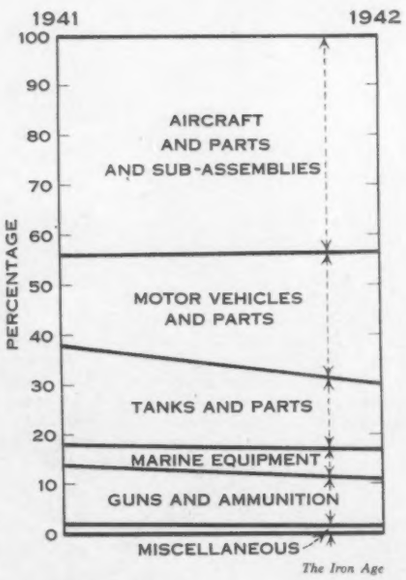
BASED on index figures developed from dollar amounts, this chart shows how automotive industry orders are divided between armament categories. It is notable that aircraft orders, including airframes, engines, propellers and parts, as well as complete ships, are the biggest single endeavor of the industry, with military vehicles and parts—including tank destroyers, special types and more orthodox cargo and troop carriers—running second. But deliveries of the vehicles to date have progressed farther, as the chart shows, than in the aircraft field, a new one to the industry.

when the fighting ends. The logic of the situation calls for an effort by these producers to find means of utilizing their equipment, and entry into the auto business is therefore a reasonable anticipation. Reasonable, that is, from a theoretical standpoint. From the practical side, the entry of new producers into the automotive field is fraught with many difficulties—the development of dealer organizations, the need for intimate familiarity with automotive procedures and sales methods, the tasks of developing market and acceptance for the new product. Efforts of aircraft or other producers to move into the automotive field are bolstered with reports that they are doing experimental work, but as yet no one has turned up with concrete evidence of these claims. Such stories must be considered only casually for some time ahead. The very concentration of the aircraft producers on their armament programs would leave them little time to do the great amount of research and development work necessary as prelude to the production of passenger cars.

What lies ahead in the oncoming year of 1943 for the automobile industry?

First of all, a tremendous increase in volume is in direct prospect, barring an unforeseen sudden ending to the war. The automobile industry production total amounted to $4,500,000,000 during 1942 and it will undoubtedly go upwards of $10,000,000,000 during 1943, unless materials problems become far worse than anyone expects them to be. Capacity, meanwhile, will probably be sufficient to turn out some $15,000,000,000 in goods, if all facilities ran at peak. Naturally this will not happen—truck capacity, for example, is already far beyond war need.

The greater share of the increase will be in aircraft parts. Correlating with the national program of augmented plane volume, industry schedules for airframe sections, engines and appurtenances thereof have been importantly increased during the past several weeks. At the same time many contracts for shells, anti-aircraft guns, tanks and other pieces of equipment were shaved down and in some cases eliminated altogether.



THIS chart shows how order accumulations have changed in the auto industry during the past year. Commitments on aircraft requirements are about the same at the end of 1942 as at the end of 1941. Total orders on all types of motor vehicles have gained at the expense of tanks; marine equipment orders are ahead to about the same extent that gun and ammunition orders are lower.

Coupled with the aircraft volume enlargements will be marked increases in manufacture of electrical controls for aircraft. The automobile industry's suppliers have been very important in this field. Their activity will increase in leaps and bounds during 1943, large as it was at the start of this year.

More and more, too, the aircraft industry will rely upon automotive industry forge shops for much of its requirements. For instance, one automobile company will soon be virtually the only source of propeller blades in the country. Another will supply most of the crankshafts required. Magnesium forgings are also being turned out at various plants throughout the automobile industry in considerable volume.

Castings are, of course, not as important in the general war program as are forgings, particularly in the aircraft requirements. But the well equipped automobile foundries, pouring cast iron, steel, magnesium and aluminum will continue to provide a large proportion of such requirements during 1943.

The one product of the automotive industry which "fits" its normal peacetime pattern is the output of military trucks. During 1943 it can be expected that the volume of such vehicles will be somewhat lower than in 1942. Actual figures

(CONTINUED ON PAGE 252)

Shipbuilding, Aircraft and Women

o o o

. . . These are the three dominant war problems on the Pacific Coast. With one eye on current pressure for war materials, everyone in the West has the other eye on post-war possibilities.

o o o

BUSINESS Agent Ed Rainbow of Local No. 6 of the Boilermakers, Iron Shipbuilders, Welders and Helpers Union, San Francisco, took his pencil from behind his ear and tapped it on the counter of the union office, emphasizing each word.

"Ladies," he said gently, but firmly, "none of you gets clearance to go on the job until the International settles this thing one way or the other; until then you're out!"

His words were like the repeal of the 19th amendment to the 22 women welding school graduates who had stormed the union office seeking permission to work. Like the suffragettes who resorted to soap box oratory to gain equal rights for their sex in the field of politics during World War I, these women were not easily discouraged.

Down Tenth Street they trooped to the Furniture Mart Building, now the principal hive for federal wartime agencies. Up they went to the spanking new eighth floor offices of the War Manpower Commission, looking more like an inspection party from the Teachers Institute than belligerent shipyard artisans. They found William K. Hopkins, regional WMC director, much easier to overwhelm than the business agent of Local No. 6. From him they drew a promise that the recalcitrant union officials would be brought into line, a promise which he kept the very next day.

Hopkins, the business agent, and a representative of the Governor's office huddled and emerged with this Magna Charta:

(1). Ships must be built.
(2). Women must be employed.
(3). Women will be employed within 48 hr. on work for which they are now qualified.
(4). As soon as experience qualifies them, women will be advanced to other work in ship construction.
(5). Sanitation and health safeguards for women in the various shipyards will be provided.
(6). The same easement of women's hours under the state laws as provided in the aircraft industry will apply in the shipyards.

This Runnymede occurred early in September. Three months later, Carl Flesher, Pacific Coast Maritime Commission director told workers on the Consolidated Shipbuilding Corp., Los Angeles harbor, that he expected women eventually to constitute 40 per cent of yard crews.

As far as the shipyards are concerned, it is now clear that the March on the Boilermakers' Union broke the dike. The yards do the training. Starting pay is 95c an hour, and the journeyman's wage $1.20, part of which goes into war bonds by agreement. The migration has been, and still is, hard on employers of office help, clerks, and culinary workers, with the shipyards paying stenographers $180 a month to keep them from donning hard hats, thus setting a fast pace for businesses not having one fist in Uncle Sam's change pocket.

The girls will do all right in the shipyards despite the cartoons and funny stories. Some of them get discouraged after the first few days and go back to such light work as slaving over a hot stove or taking fares on the trolley cars. They've done all right already in the aircraft factories; in some, they'll be in the majority before spring. Donald Douglas is reliably quoted as setting his eventual feminine quota at 80 per cent. In California as a whole, the number of women employed as wage earners in manufacturing industries reached an all time high of 151,800 in October, making their ratio to total manufacturing wage earners 20.2 per cent. In April, 1942, the proportion was 12.5 per cent. Women constituted 15.9 per cent of the durable goods factories force in October against 11 per cent in September and less than 5 per cent in April, 1942.

More women were employed as factory workers in Los Angeles County alone in October than were employed in the entire state prior to July, 1942, an increase almost entirely attributable to the aircraft industry, where the ratio to men is not announced, but probably will be close to 40 per cent by the time this appears in print. Last October, 58,500 women were employed in aircraft plants.

The blondes, the slacks and the

(CONTINUED ON PAGE 256)

THE IRON AGE Price and Production Summary

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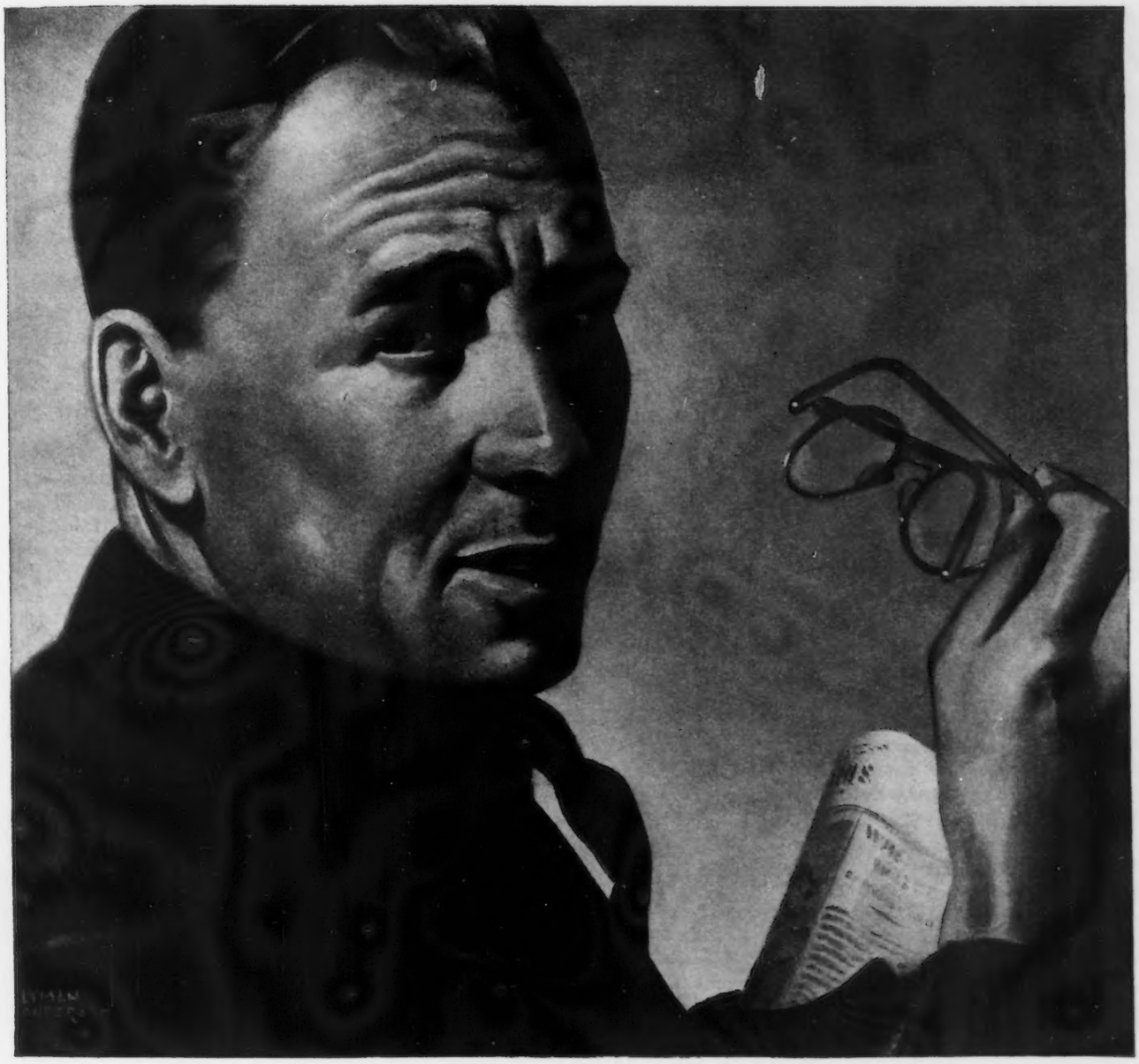
(Statistical Section Is Continued on Page 196)

United States Pig Iron Production—*Thousands of Net Tons*

Including ferroalloys made in blast furnaces, but excluding charcoal iron. Source: THE IRON AGE

	Jan.	Feb.	Mar.	April	May	June	½ Year	July	Aug.	Sept.	Oct.	Nov.	Dec.	Second Half	Year
1901	1,301	1,270	1,433	1,408	1,500	1,476	8,388	1,523	1,496	1,456	1,548	1,526	1,418	8,967	17,355
1902	1,599	1,409	1,618	1,652	1,728	1,621	9,627	1,615	1,644	1,589	1,659	1,605	1,722	9,834	19,461
1903	1,649	1,558	1,668	1,801	1,920	1,874	10,470	1,732	1,760	1,741	1,596	1,163	949	8,941	19,411
1904	1,035	1,353	1,625	1,748	1,721	1,452	8,934	1,256	1,314	1,521	1,630	1,664	1,810	9,195	18,129
1905	1,996	1,789	2,168	2,153	2,200	2,007	12,313	1,951	2,065	2,127	2,229	2,256	2,292	12,990	25,303
1906	2,317	2,133	2,425	2,323	2,349	2,214	13,761	2,255	2,158	2,208	2,461	2,450	2,503	14,035	27,796
1907	2,471	2,290	2,493	2,485	2,571	2,503	14,813	2,527	2,520	2,446	2,506	2,047	1,382	13,428	28,241
1908	1,171	1,207	1,375	1,288	1,306	1,223	7,570	1,364	1,523	1,589	1,756	1,767	1,950	9,949	17,519
1909	2,014	1,912	2,056	1,948	2,109	2,162	12,201	2,355	2,519	2,671	2,912	2,853	2,952	16,262	28,263
1910	2,922	2,625	2,932	2,782	2,677	2,537	16,535	2,407	2,360	2,303	2,344	2,139	1,991	13,544	30,079
1911	1,971	2,011	2,433	2,314	2,121	2,004	12,854	2,008	2,158	2,214	2,355	2,240	2,288	13,263	26,117
1912	2,305	2,352	2,694	2,660	2,815	2,734	15,560	2,700	2,813	2,760	3,013	2,947	3,116	17,349	32,909
1913	3,130	2,896	3,096	3,083	3,161	2,945	18,311	2,867	2,852	2,807	2,852	2,501	2,222	16,101	34,412
1914	2,111	2,115	2,630	2,542	2,344	2,148	13,890	2,193	2,234	2,109	1,992	1,700	1,698	11,926	25,816
1915	1,793	1,887	2,312	2,370	2,535	2,667	13,564	2,871	3,114	3,195	3,501	3,401	3,587	19,669	33,233
1916	3,567	3,458	3,740	3,614	3,764	3,596	21,739	3,611	3,589	3,586	3,930	3,710	3,559	21,985	43,724
1917	3,529	2,963	3,642	3,735	3,827	3,662	21,358	3,743	3,538	3,510	3,699	3,591	3,229	21,410	42,768
1918	2,701	2,596	3,599	3,683	3,861	3,723	20,163	3,832	3,796	3,828	3,904	3,757	3,846	22,963	43,126
1919	3,699	3,293	3,461	2,775	2,361	2,369	17,958	2,721	3,072	2,787	2,087	2,679	2,949	16,295	34,253
1920	3,377	3,337	3,781	3,068	3,344	3,409	20,316	3,435	3,525	3,504	3,688	3,287	3,029	20,468	40,784
1921	2,705	2,169	1,788	1,336	1,368	1,193	10,559	969	1,069	1,104	1,396	1,585	1,857	7,970	18,529
1922	1,842	1,826	2,280	2,321	2,583	2,566	13,496	2,694	2,034	2,278	2,956	3,191	3,475	16,610	30,106
1923	3,617	3,353	3,947	3,976	4,332	4,117	23,342	4,119	3,864	3,501	3,527	3,241	3,272	21,524	44,866
1924	3,382	3,441	3,883	3,622	2,929	2,269	19,526	1,999	2,114	2,299	2,774	2,811	3,318	15,315	34,841
1925	3,774	3,600	3,992	3,650	3,283	2,995	21,294	2,984	3,030	3,052	3,386	3,386	3,640	19,478	40,772
1926	3,714	3,274	3,855	3,864	3,900	3,623	22,230	3,610	3,586	3,512	3,734	3,626	3,461	21,529	43,759
1927	3,477	3,294	3,901	3,832	3,798	3,461	21,763	3,305	3,300	3,108	3,118	2,966	3,020	18,817	40,580
1928	3,214	3,248	3,585	3,567	3,678	3,452	20,744	3,441	3,514	3,429	3,779	3,698	3,774	21,635	42,379
1929	3,855	3,591	4,160	4,102	4,366	4,163	24,237	4,239	4,207	3,918	4,019	3,563	3,177	23,133	47,360
1930	3,166	3,180	3,636	3,564	3,620	3,286	20,452	2,956	2,827	2,550	2,425	2,092	1,866	14,716	35,168
1931	1,920	1,912	2,276	2,261	2,233	1,836	12,438	1,639	1,435	1,309	1,314	1,235	1,098	8,030	20,468
1932	1,089	1,080	1,084	954	877	704	5,788	640	582	663	721	707	612	3,925	9,713
1935	637	621	607	699	993	1,417	4,974	2,007	2,053	1,705	1,519	1,215	1,323	9,822	14,796
1934	1,361	1,416	1,813	1,934	2,288	2,162	10,974	1,372	1,181	1,006	1,065	1,072	1,151	6,847	17,821
1935	1,654	1,802	1,983	1,863	1,934	1,739	10,975	1,702	1,972	1,990	2,215	2,315	2,360	12,554	23,529
1936	2,269	2,042	2,285	2,693	2,966	2,896	15,151	2,905	3,037	3,058	3,351	3,301	3,489	19,141	34,292
1937	3,597	3,359	3,874	3,799	3,960	3,481	22,072	3,919	4,039	3,819	3,239	2,248	1,669	18,933	41,005
1938	1,601	1,454	1,627	1,541	1,406	1,189	8,818	1,346	1,673	1,882	2,298	2,543	2,476	12,218	21,036
1939	2,436	2,307	2,682	2,303	1,924	2,373	14,025	2,639	2,979	3,224	4,063	4,167	4,220	21,292	35,317
1940	4,032	3,311	3,270	3,137	3,514	3,819	21,083	4,054	4,238	4,177	4,446	4,403	4,548	25,866	46,949
1941	4,664	4,198	4,704	4,334	4,600	4,553	27,053	4,771	4,791	4,717	4,856	4,703	5,012	28,850	55,903
1942	4,971	4,500	5,055	4,896	5,073	4,935	29,430	5,051	5,009	4,937	5,237	4,966	5,131	*30,602	*60,032

*Estimate



Now, Here's A REAL Dictator!

WHEN it comes to dictating, the great American consumer has them all beaten! As far as he's concerned, getting the best is very simple.

You just ask for it!

But supplying the best is not a simple matter for the manufacturers on whom this great dictator is casting his shadow—especially in the case of the new products he is expecting as soon as peace is declared.

Automobiles at half the cost, that go twice as far to the gallon! Houses that cost no more than a good car, but with all the conveniences of a palace! Household equipment that will be compact and indestructible! Air conditioning, radiant heating, television, electronic household controls...

And priced so that the average American can afford all of them!

American industrial ingenuity *will* give the consumer what he wants. But it will take revolutionary practices. And often the use of apparently fantastic materials.

Of course the war has brought about the eager testing of every material that research and metallurgy could devise. And many of these substitutes have earned a definite place in the field of metallurgy.

But which material? Under what circumstances? For which specific application?

Revere can help answer many of the questions that beset industry. For just as industry in the future will not be restricted to the traditional materials, neither will Revere. Since the war started, in addition to widening still further the uses for copper and its alloys, Revere has gained wide experience with the light metals, and has developed wholly new kinds of alloys with important properties that can cut manufacturing costs for many industries.

With this great expansion in the range of Revere metals, you can be sure of singularly impartial service from Revere. Today, the copper industry is working all-out for Uncle Sam. No copper is available except for winning the war. But post-war planners with specific problems in metals are referred directly to the Revere Executive Offices in New York.

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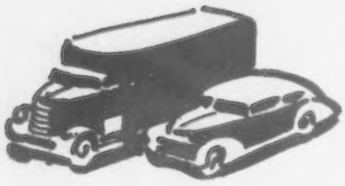
Assembly Line . . .

• Story about standard power plant for all medium tanks stirs up confusion . . . G.M. has 11,209 more new machine tools coming . . . Price ceiling on parts believed to be in prospect.



DETROIT—Rarely has such confusion and controversy developed as was stirred up by the statement that one standard power plant had been selected for medium tanks.

The story properly begins a few weeks ago when Brig. Gen. Alfred H. Glancy, chief of the Tank-Automotive center of Ordnance at Detroit, told a closed meeting of auto engineers and ordnance officers that standardization had been decided on and one engine chosen. The closed meeting inadvertently housed a daily newspaper reporter, and the story was in print the next morning.

Broad hints were heard and reached print that the chosen engine was produced by the Ford Motor Co., but no official confirmation of this claim came from Ford. It long has been rumored that there were three types of medium tank engines in quasi-experimental production at Ford. There was no indication which one the Ordnance Department may have settled on.

Meanwhile, these reports were rather disturbing to Continental Motors Corp., presently the largest producer of tank engines. Continental has been adamant in its stand that it would be the bulk producer. Following Brig. Gen. Glancy's remarks, C. J. Reese, Continental president, said that "as far as 1943 is concerned, Continental Motors is charged with the production of more tank engines than any other company."

The Ford stories and the Continental viewpoint can both be right. Any tank engine manufactured by Ford would have considerable expansion to go before it could fill all production requirements. Time for tooling would be needed. Continental, meanwhile, would continue as the topmost tank engine maker.

No matter what standardization may be set up, however, some tanks likely will continue to be produced with diesel engines. This is necessitated by varying conditions of climate which the tanks may encounter in warfare. At the same time, any tanks which are made for Lend-Lease conceivably could be powered differently than those produced for the United States Army. Tank "standardization," insofar as power plants are concerned, appears more academic than actual.

Auto Sales Slow

The bright light of armament developments has pressed down so hard on the automobile industry in recent months that the course of retail automobile sales has been all but forgotten. The sales have been steadily slipping. The drop-off since September is attributed to worry over gasoline rationing and desire on the part of some dealers to wait for 1943 business, inasmuch as their 1942 showings have been fairly good and they do not wish to move into higher excess profits tax brackets with more income in this calendar year.

The OPA director of auto rationing, Hubert Larson, said that about 250,000 new cars remain in the country in dealer stocks—110,000 of which are in the so-called pool A, which is to be cleaned up, according to plan by March 1st. The remaining 140,000 pool B cars are destined for post-March sale.

G.M. Machine Orders

At the present rate of deliveries, machine tool orders outstanding from General Motors Corp. will be cleaned up in about four months. New orders, being released all the time, naturally will extend the backlog, but volume of unfilled orders has been steadily falling for the past several months.

Since the start of the arms program about two years ago General Motors has ordered 49,087 new machines, including both machine tools and such machines as sewing machines, presses, welding equipment, etc. Of these, 37,878 deliveries have been made, leaving 11,209 still undelivered. Present delivery rates are running between 2,500 and 3,000 units per month.

The bulk of this new equipment is owned by the United States Government, which holds title to 27,061 units. The British Purchasing Commission owns 1,900 and other contractors are the titular owners of 649.

As of today, General Motors itself owns 82,791 machines and machine tools, the total in all plants being 112,407. Of these 19,590 are still idle today—mainly presses and special purpose machinery, representing approximately 25 per cent of pre-war equipment. Present holdings are reduced from earlier totals by 1,460 machines sold to other companies, 846 sold to government agencies and 422 consigned to sub-contractors.

These figures were made public by C. E. Wilson, president of General Motors, last week. Other highlights of his report included these:

DELIVERIES of war materials from corporation plants amounted to $1,699,941,198 for the first eleven months of 1942, November deliveries totaling $247,685,749. The decrease from October's volume of $248,405,560 was due in part to the two less working days available in November as against October, as well as to some cutbacks in government arms schedules, and to savings passed along to the government in the form of price reductions.

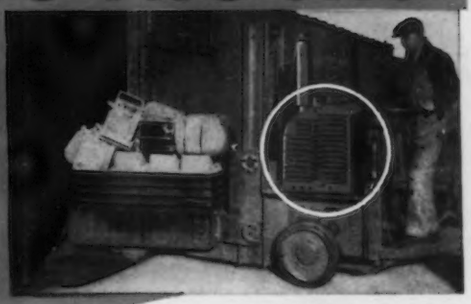
Employment as of the week ended Dec. 20 totaled 288,542 hourly paid workers. Salaried workers totaled 68,136. The peak for salaried workers is estimated at 70,002, indicating that forthcoming increases in production divisions will not have to be accompanied by many more white-collar jobs. In fact, Detroit and some other cities will see actual reductions made in salaried help during the next several months.

Absenteeism is twice normal, attributed to the long hours, high earnings and prevailing transportation difficulties. Among men, absenteeism of one week or less for personal reasons is normally 1.5

READY-POWER

EQUIPPED ELECTRIC TRUCKS

Gas-Electric
POWER PLANTS
for
ELECTRIC TRUCK OPERATION



CONTINUOUS POWER

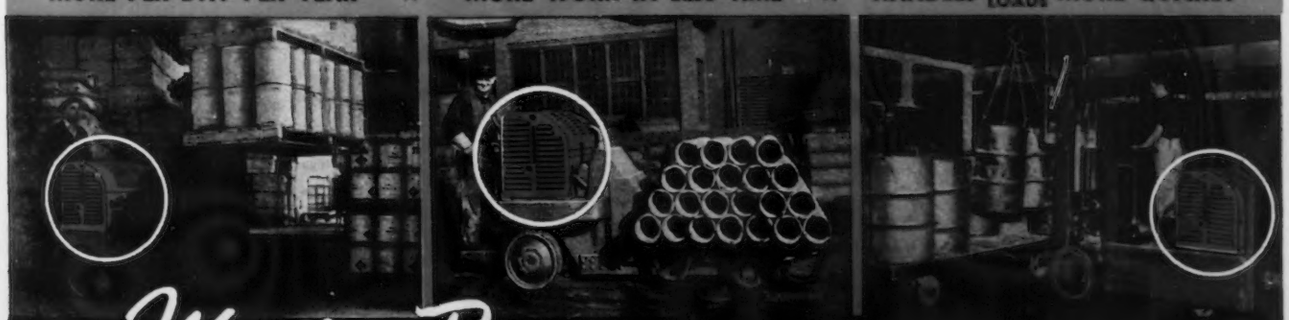
READY-POWER (Gas-Electric) Units on *new* or *existing* electric truck equipment handle more loads per hour per day and per year than the same equipment battery powered. This means a saving in time as well as a saving in money by accomplishing a given amount of work in less time at a lower cost per ton handled. Since 1924, thousands of Ready-Power Units have been adapted by industry to their toughest jobs. READY-POWER'S reliability and superior performance have been proved. Ask for literature.

PEAK PERFORMANCE

READY-POWER today serves industry *better*, more *completely*, than ever before with power units that cover the range of trucks from 2000 to 60,000 pounds rating. READY-POWER manufactures a complete line of Gas-Electric Power Units—*not complete trucks*. You can secure *new trucks* complete with READY-POWER from truck manufacturers or you can get READY-POWER units to replace batteries for trucks now in operation in your plants.

Write for information, mentioning type of new trucks contemplated or make and type of trucks now being operated.

MORE PER DAY PER YEAR ★ MORE WORK IN LESS TIME ★ HANDLES MORE LOADS MORE QUICKLY



Get *Wartime Power* for your NEW or PRESENT Trucks

THE **READY-POWER** CO.

3841 GRAND RIVER AVENUE ★ DETROIT, MICHIGAN, U. S. A.

per cent; the proportion has advanced today to 3 per cent, although there has been no notable growth in absenteeism since September. The week-or-longer absentee proportion of about 1 per cent, attributed to sickness, has not changed noticeably.

Female absenteeism, normally averaging 2 per cent, stands today at about 4 per cent. New employee absentee volume is much worse than records of old employees, although the trend is a general one.

Approximately one-third of General Motors plants are operating at capacity today. All will reach projected capacity or maximum service requirements production rate by the end of 1943.

The slower turnover of inventory for military products as compared with civilian passenger car production makes it necessary to carry about 50 per cent more raw materials in relation to sales turnover than was done in normal times.

Average working schedules run between 46 and 47 hours a week today. Pressure has ended on plant preparation and tooling work, although it still bulks important.

New Factory Floor

Something new in factory floors is underfoot at the Wright Aircraft engine plant operated by Studebaker at South Bend.

Ralph Vail, Studebaker vice-president in charge of production, sought a floor which could be kept fairly clean with a minimum of difficulty. To this end, the building specifications ordered a concrete base overlaid by a stratum of composition materials, covered by tar paper and topped with another layer of composition. On this surface longitudinal stringers of steel were set in at 18 in. intervals and to these were anchored, in tongue and groove fit, inlaid strips of maple 1⅛ in. wide, ⅞ in. deep and 18 in. long.

This gives a flooring of at least the resiliency of creosote blocks, and one of light color which reflects the ceiling's fluorescent lamps and thus increases the light within the factory. About a dozen sanders are constantly at work in the plant going over this inlaid flooring and restoring it to a factory ultimate in cleanliness.

Kaiser Plan Rebuff

A tempest has been stirred up in the automobile industry by the proposal of shipbuilder, Henry J. Kaiser, that the automobile industry design its 1945 models now and sell them in advance, using war bonds for down payment and subsequent payments.

First to take exception to Kaiser's statement was J. W. Fraser, president of Willys-Overland Motors, Inc., who called a hasty press conference as soon as he had heard Mr. Kaiser's speech before the National Association of Manufacturers. Mr. Fraser told reporters that the proposals he had just heard constituted an unwarranted reflection on the war effort of the auto industry.

At the same time, automobile industry sources have little more use for the Kaiser proposal to use war bonds to pay in advance for cars than they have for similar proposals made by Elliott Nugent of OPA sometime back. They say simply they do not know what the post-war cars will look like, nor how much they will cost. And they do not believe the American public will buy something sight unseen. Additionally, they fear the idea smacks of the German Volkswagen, the "peoples' car" which has been sold to Germans since 1938 on an installment plan but which has not appeared yet in civilian life, only on the battlefields of North Africa as a military vehicle.

Parts Price Ceiling

Maximum price regulations are in prospect for parts, covering both manufacturers on the one hand and with wholesalers and retail dealers on the other to discuss the proposals. Some quarters anticipate that formal price fixing action will be taken by OPA this month.

Maximum prices on parts without manufacturers' list price would be at the top levels received as of March 31, 1942. Where manufacturers had retail list prices, the ceiling price would not exceed the list price plus sales tax where applicable and excise tax when not included in the list price.

Rebuilt, repaired and guaranteed used parts would be at the top levels of March 31 if the manufacturer had issued a retail price list at that time. Without such lists, the price would be the topmost level in effect last March 31st, if it was sold at that time. For cases not otherwise covered, the maximum price would be 85 per cent of the manufacturer's suggested list price for the same part new.

Parts sold "as is" would be at no more than 55 per cent of the suggested retail list price, or 55 per cent of the comparable new part as listed by the manufacturer of the vehicle from which the part was removed.

BULLETIN BOARD HUMOR: The women who transport boxes and crates for Boeing Aircraft Co. read a "warning" posted for their benefit.

Working Data to Help You Get the Most From Every Pound of Stainless Steel!

Here is the kind of practical production and engineering information you have been looking for—helpful hints on fabricating procedure, detailed data on Stainless Steels to meet government specifications and various conditions in service.

In the *Selection* and *Description Sections* of this Working Data Book you will find the basic information you need when considering Stainless Steel to meet specific design or engineering requirements.

The *Fabrication Section* (shown above) is a result of the diversified experience of Carpenter's service representatives. These men spend much of their time in production departments, where new fabricating problems must be solved *fast*. And in keeping with Carpenter's policy of sharing its "know how" with users of Stainless Steel, this information is now offered to you in printed form.

This 98-page book, "Working Data for Carpenter Stainless Steels," is offered to users of Stainless Steel in the United States. A note on your company letterhead is all that is needed to start a copy on its way to your desk. Drop us a line today.

Quick Answers to your questions about Stainless Steel!

Here are just a few of the many subjects cross-indexed in this new Working Data Book, offered to users of Stainless Steel in the U.S.A.—

- Heat Resisting Steels for High Temperature Service
- Stainless Steel to Combat a Specific Type of Corrosion
- Stainless Steels to Meet U. S. Gov't Specifications
- Physical Properties of Carpenter Stainless Steels
- Alloys for Electrical and Low Expansion Purposes
- Relative Workability, etc.

The Carpenter Steel Company
121 Bern Street, Reading, Pa.

Carpenter STAINLESS STEELS

BRANCHES AT Chicago, Cleveland, Detroit, Hartford, St. Louis, Indianapolis, New York, Philadelphia

Washington . . .

• Obtaining right thing at right time in right place remains constant problem still taxing ingenuity of American industry and government.

WASHINGTON—The biggest government venture ever undertaken is not Boulder Dam. It is not even fighting a global war. It is logistics—the marshalling of the right thing at the right time and at the right place to fight that war. How it is going to be done remains a question after more than two years of trying, still taxing the ingenuity of American industry and government.

The struggle now is to "solve the solution"—since it has been determined that production scheduling on a national scale is the solution. The kind of scheduling industry may expect has not been spelled out by the war agencies, though the principle of scheduling is adopted by all government agencies concerned in CMP. Moreover, it is generally agreed that scheduling is the only way to manage the elements of raw material, labor, production rate, etc., to adequately arm and supply our fighting forces and still support a civilian economy. The system of scheduling which first emerges may be expected to be revised and in the light of past experience with government planning will probably be greatly refined when the majority of the "bugs" are taken out.

This article is a symposium of the ideas of many of the more influential and policy making officials of Washington officialdom and after study appears to be the scheduling plan which will finally emerge. In general, the plan is to start with the individual plant, expand to industrial areas and finally incorporate all of the information obtainable on end product, raw and fabricated material capacity in an all inclusive schedule of national production.

ESSENTIALLY, national scheduling is a time study, a time study involving everything having to do with production rate including all of the factors which influence it, such as geography, transportation, labor, management, engineering and strategic planning on the part of the Army and Navy. What is acknowledged as one of the greatest obstacles is the fact that both government and industry need an understanding of what scheduling means.

Smaller prime contractors have expressed apprehension about the size of the job of developing bills of material which they concede is general practice in the larger companies that made up the automobile industry in peacetime. In the war agencies themselves, there is a considerable amount of disbelief that the government will be able to get the bills of material in sufficient quantity to establish requirements.

Before scheduling can be done, the following information must be well known: The type, number and varieties of weapons to be made and when delivery is desired; the kinds, specifications and amounts of raw and fabricated material required to meet the programs together with estimates of the amounts of such material available (production time factors), and the end and component capacity of every factory within every program.

Practical requirements must be established by months for future quarters on individual products and the first schedule to be drawn according to government officials, should determine the approximate relative conformity of the military "shopping list" with material requirements. All schedules should be integrated after they are drawn and corrected for errors in estimates and be so flexible that they can reflect changes in capacity, weather conditions, transportation breakdowns, labor supply, etc.

Next, two interlocking schedules should be drawn for every production, a component schedule and individual tentative end production schedule. These do not have to be submitted to Washington unless requested but should be made for the benefit of the plants themselves.

THE component schedule, as provided for by CMP, should detail the component completely and this should be done for every part, assembly or sub-assembly. Some difficulty is presented, however, since some end products contain hundreds of individual components. The problem can be met by the presentation of engineering estimates of repetitive items, spare parts and maintenance spares. Some components may be even beyond the jurisdiction of the agency handling the end product and may be in the jurisdiction of WPB. Despite this trouble, schedules are to be adjusted to take care of the items which are not schedules but are bulked under what WPB may issue soon as a modified PRP.

Tentative individual end product schedules must have the support and justification of specifications and a list of the component parts. This is a job for a production engineer familiar with the facility with which he is dealing and the manufacture of the end product. The elements of labor supply, transportation, etc., must be weighed and should be so done that a competent person can check the estimates. Tentative end product schedules must be correlated regionally and by plants so that the information can be incorporated into consolidated schedules which may include several industrial subdivisions and finally become adjusted into a Master End Product Schedule to go to the claimant agency. Much of the work will be accomplished in the field by government representatives in conference with industry over individual schedules. As tentative individual end product schedules are approved contracts may be let.

Local plant schedules are summarized and built into consolidated schedules which in turn make up master end product schedules, for industrial divisions. Totaled figures will appear in the National Master End Product Schedule which is a requirement schedule to be checked

Maybe the Basic Engineer Can Help

When furnace delay time seems high . . .

When refractory costs get out of line . . .

When you have excessive bottom trouble . . .

That's the time to call in the *Basic Engineer.*

You know this man, of course—may call him by his first name. His job is to be your helper—your refractories service man.

Every *Basic Engineer* is a practical steel man, with years of experience in steel making. He knows refractories—knows how they will stand up under the varying conditions met in an open hearth or electric furnace.

Especially now, he is prepared to help deal with emergency refractory problems likely to arise from continued operation of your furnaces at near capacity levels. He will supervise and assist with the installation of new hearths, or major repairs, or special applications. You may want his suggestions on hearth maintenance.

If you are to deliver maximum production from your furnaces in 1943, you can't afford to take chances on refractories. So call in the *Basic Engineer.* Give him your refractory jobs to do.

BASIC REFRACTORIES, INCORPORATED

845 HANNA BUILDING ● CLEVELAND, OHIO

Magnefer • Syndolag • Ramix • Hearth Patch
Basifrit • 695 Plastic • Gunmix • Raw Dolomite

against the original approximated schedule, mentioned earlier.

WAR agency officials emphasize that so much of the confusion which has been felt by industry about CMP has to do with the plan's description of scheduling and the basis for scheduling the bills of material. The agencies say that they are not so interested in getting the bills as they are in feeling confident that industry is making them up for their own benefit. Even CMP will require more reporting than was originally expected and the responsibility of this too rests with industry. Production time tables will have to be maintained starting from the single plant and expanding to the entire industrial machine. The production timing of every fabricated part, assembly and sub-assembly must be discovered and recorded and built into a master time interval schedule. It is proposed that standard time be adopted for the entire country for this purpose.

Capacity information in the shape of shop loading schedules showing orders scheduled per week and month should be submitted so that WPB or the claimant agencies can determine whether certain shops are overloaded or are in need of work, so that contracts may be shifted on this basis. These schedules will also reveal important information concerning the need for expansion and where labor or machines are needed.

The reporting system must work, or the purpose of all scheduling—the ability to push the "middle bell down and have the music come out there" will be defeated. Component schedules, time interval schedules and shop loading schedules should be kept so current as to reflect every production change no matter what the cause.

Getting and shaking down time interval and shop loading schedules will be the responsibility of field men from the claimant agencies and WPB. These schedules before they are incorporated into overall national schedules should take into account undue optimism or conservatism.

The immediate job is to place schedules, it is said, on a realistic basis for current production programs where no schedules are available. This is thought to be more expeditious than scheduling new requirements for new products at first. The reason is that experience makes available data more complete.

THE BULL OF THE WOODS — BY J. R. WILLIAMS

'AT AIN'T RIGHT-- IT AIN'T FAIR! WHY DON'T YOU TAKE TH' GUYS NEXT TO ME FER THEM ROTTEN JOBS? WHY? BECAUSE THEY KIN ONLY RUN TH' ONE MACHINE AN' GIT AS MUCH DOUGH AS ME, AN ALL-ROUND—
WELL, JOE'S OFF TODAY AN' WE GOT TO KEEP THAT PLANER GOIN', DAVE!
DAVE, HEES NO LAK DEES --HAH! HE LEARN DE MACHINIST TRADE, NOW HEES SQUEAL LAK 'PEEG --HA-HA!
HA! HIM YAPPIN'! WHY, WHEN I WAS STUDYING MEDICINE HE BROUGHT ALL HIS ACHES AN' PAINS TO ME FOR FREE ADVICE !
J.R.WILLIAMS
T. M. REG. U. S. PAT. OFF. COPR. 1943 BY NEA SERVICE, INC.
THE MAN OF THE HOUR
1-8

Steel Centers Back to Normal After Floods

• • • **Pittsburgh and** midwestern steel making areas were back to normal this week after flood conditions threatened to rival the 1936 flood, at which time water reached 46 ft. or 21 ft. above flood level at Pittsburgh. All steel making units at Pittsburgh, Wheeling, Steubenville, Youngstown, and other valley locations had completely recovered this week after an exceptional comeback following a short cessation at some plants where both pig iron and steel production was either drastically curtailed or completely stopped.

Flood conditions at Pittsburgh reached a stage of 36.6 ft. or 11.6 ft. above flood level. This was high enough to force down the blast furnaces and steel works of Jones & Laughlin Steel Corp. at Pittsburgh. Blast furnaces at Mingo Junction of Carnegie-Illinois Steel Corp. were also banked because of high water. Some blast furnaces and certain finishing mill operations were slightly affected at Carnegie-Illinois Steel Corp.'s Pittsburgh district plants. Other smaller steel units along the Allegheny River such as Crucible Steel Co. of America's Labelle and Park works were also forced to cease operations.

In the Youngstown district, Republic Steel's blast furnaces were put on slow wind with a consequent curtailment in steel output and one large finishing mill was shut down temporarily when high water threatened to get into the motors. In order to conserve natural gas which was threatened by a pipeline break, Republic Steel at Youngstown shifted to a coke oven producer gas mix in operations, thus conserving natural gas for other purposes.

Youngstown Sheet & Tube Co. missed shutting down its blast furnaces and open hearth departments by a hair's breadth when water came within 2½ in. of the stage which would have meant complete curtailment of all operations at the plant.

Although some steel production in the Pittsburgh, Youngstown and Wheeling district was lost due to shutdowns, there is a slight chance that a portion of this may be recovered in subsequent months by an extra speed up of facilities.

Suggestions for MORE EFFECTIVE INSPECTION PRACTICE

1 Establish a definite wear allowance for all fixed size gages, plugs, rings, etc.

2 Check these gages periodically to determine when wear has eliminated this allowance.

3 In final inspection it is better to use an instrument than a fixed size gage when the wear allowance of the gage by the 5-10% rule is established at .0001″ or less. Here the human factor is usually important enough to outweigh the effect of the wear allowance and gaging results become questionable.

4 It is ordinarily not best to use a conventional snap gage for the inspection of work having a manufacturing tolerance of .002″ or less.

5 Keep plugs and rings oiled when not in use.

6 Be sure that both work and gage are clean before they are brought together.

7 Periodically check your precision gage blocks for wear, against a set of certified blocks. Redesignate them when wear is revealed.

8 In setting a comparator gage be sure that both gage and precision blocks are at the same temperature.

9 It is well to check the calibration of indicating type comparators periodically. If an error is found, it is better to send the comparator back to the factory for recalibration.

10 If you are using Multichek gages insist on the operators handling them smoothly. Work should never be jammed violently into gaging position.

Sheffield Engineers

are authorities on precision inspection. Get their advice on questions relative to gaging and Dimensional Control.

SHEFFIELD GAGES
MASTER GAGEMAKERS

THE SHEFFIELD CORPORATION
DAYTON, OHIO, U. S. A.

WEST COAST . .

• Fontana blast furnace lighted Dec. 30, and by-product coke plant starts operation at Tacoma . . . Other new facilities will come in soon . . . Miller enters scrap controversy.

SAN FRANCISCO—To the American Institute of Independent Small Business and Industry, Congressman Richard J. Welch of the Fifth District of California writes as follows supplementing his recent address to the Congress:

"Despite continuous increases of population in the West, the natural growth of industry is hampered by needless freight charges which are caused by eastern interests who oppose the opening of western mines. In fact, there are today fewer furnaces west of the Missouri reducing iron ore to metallic iron than three decades ago.

"I advocate . . . more furnaces . . . close to the resources . . . making steel and iron casting plentiful . . . small business will have a chance."

This is an old story with Congressman Welch who has faithfully represented the point of view of organized labor and the little fellow for over 40 years, in the Senate of the State of California, on the Board of Supervisors of San Francisco and for the past six years in the National Congress.

But Mr. Welch should bring his facts and figures up to date. Never has there been so marked a change in the raw material production facilities for heavy industry west of the Rocky Mountains and on the Pacific Coast than during the past 12 months, coming to a climax now and in the next few months.

Despite a serious butane explosion that caused $75,000 damage to storage equipment, the 1200-ton blast furnace was first heated for production Dec. 30, at Fontana, the first pig iron facility within fog-belt communication of Pacific tidewater. Almost simultaneously, the Wilkeson Products Co. starts operation of a 17-oven by-product coke plant at Tacoma with annual capacity for approximately 75,000 tons, the first extensive facility for the reduction of Washington coking coal.

PRODUCTION starts about March 1 in a new 30,000-ton electric furnace and rolling mill at Portland, independenly owned and the first steel rolling facility between Puget Sound and the Golden Gate.

When Provo and Geneva swing in with a million and a quarter tons from Utah within a few months, it appears that the Pacific Coast will have more pig iron and steel rolling facilities than it may have men and good ore and economical coke to operate them. For all these emergency facilities depend upon expensive and constricted rail transportation. When, again, under more normal times of peace, we return to intercoastal freighters hungry for West bound tonnage, and when emergency ceiling schedules shall have been removed to allow supply and demand to set their own price levels, there seems no good reason why economical large scale steel production near Atlantic tidewater together with economical inter-coastal boat rates should not again land steel on the Pacific Coasts at prices to pinch the new far western steel makers, backed so liberally by public emergency funds.

Congressman Welch serves an excellent purpose in reminding the nation of the industrial growth and importance of the Pacific area. But he will better serve his cause by keeping himself well up to date on the facts and the realistic economics involved.

Alex Miller, chief of the Scrap Section, Raw Material Branch, Steel Division of WPB, spent the last days of the old year and the first days of the new at the San Francisco regional office of WPB attempting to "coordinate" a jurisdictional misunderstanding and fairly heated controversy over the processing, allocating, stockpiling and disposal of steel scrap on and from the Pacific Coast. Community and public drives with their resultant great quantities of "hay" scrap, combined with increasing and consistent receipts of "demolition" scrap from trans-Pacific war areas have filled the yards of far western processors as well as principal mill buyers.

A few weeks ago Paul Cabot, right hand executive in the WPB Conservation Division from Washington confronted the condition when he was on the Pacific Coast and announced that 35,000 tons would be arbitrarily purchased by the Government with Metals Reserve funds, to be stockpiled or shipped to midwestern mills. Since ODT and the railroads insist that freight cars carry maximum loads over such a long haul, it was necessary to allocate prepared scrap for these purposes. When allocation orders were received by the yards for large quantities of prepared scrap under this arrangement, purchasing agents for Pacific Coast mills became so concerned and so vocal and so insistent that Mr. Miller found it necessary to give personnel attention on the scene. Far Western Regional Director Harry H. Fair is understood to have insisted that the allocating and disposing of Pacific Coast scrap be handled by a single agency with an accredited representative with final authority on the Pacific Coast. So far the Steel Division has had no Pacific Coast representative and to solve the difficulty and prevent its reoccurrence, such office and representative will probably be established, or the allocating and routing of scrap will be handled by the Scrap Processors Branch of the Conservation Division. The Federal Government, with its emergency powers and its financial restraints and incentives is now so heavily involved in the scrap situation that the actual buyers and sellers simply stand on the sidelines and root for one or the other of the opposing teams, hoping that finally someone

Heated by TOCCO to 2000° F. in 115 SECONDS for forging!

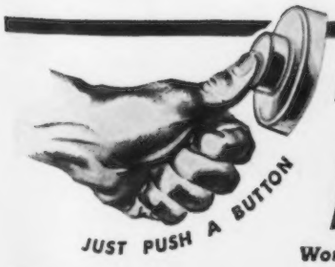
At the push of a button, the electrical induction of a cool, compact TOCCO machine goes to work on the shank of airplane propeller blades. In 115 seconds, the 4 5/16″ diameter by 9¼″ long tubular section heats to 2000° F., ready for upsetting.

That's typical of the SPEED of processing with TOCCO induction heat.

Versatile TOCCO units like the one shown are on the offensive all along the war production front ...blasting traditional schedules...saving valuable hours in hardening, annealing, heating and brazing operations. And the same standard units, with a simple change in work fixture, will cut costs and improve products for the post-war battle of competition.

Write for the new TOCCO booklet.

THE OHIO CRANKSHAFT COMPANY
Cleveland, Ohio



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HARDENING
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forming and forging

will dominate the field sufficiently to establish playable rules.

THIS establishment of the Wilkeson coke plant at Tacoma with an annual capacity of approximately 75,000 tons is of more than local significance. In fact, the Defense Plant Corp. is financing the plant to help reestablish coke production in the Pacific Northwest which has dwindled and languished in recent years.

Pierce County in Washington, around the base of Mt. Ranier, is estimated to have between 125,000,000 and 60,000,000 tons of recoverable coal within economic limits of depth, according to an investigation of U. S. Bureau of Mines prepared by Prof. Joseph Daniels. Up to the end of 1937 there had been mined from the Wilkeson Carbonado and Fairfax areas of Pierce County 21,137,033 tons of coal, and during the same period beehive ovens produced over one and a half million tons of coke. In 1915 coke production from Washington was 136,552 tons of which over 100,000 tons was beehive. But by 1936 Washington's coke production had been reduced to 28,680 tons with only 312 tons from beehive ovens.

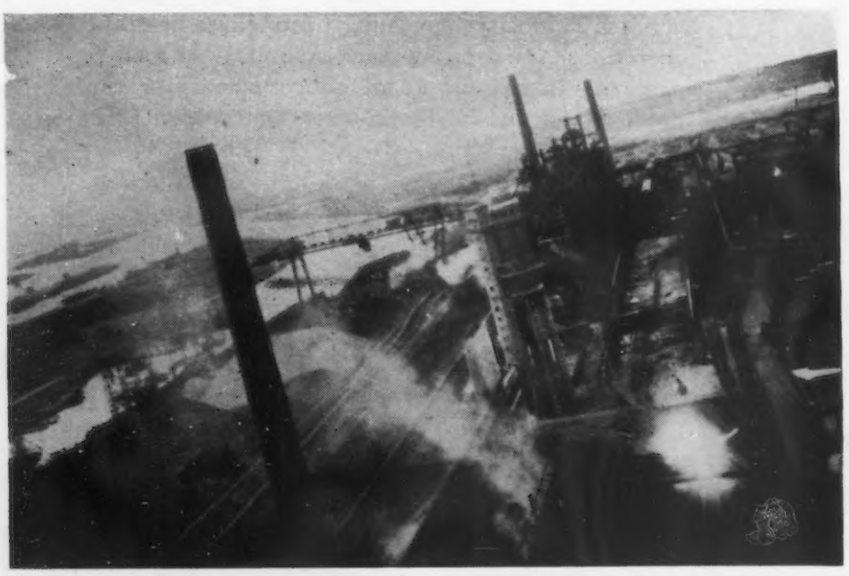
ACCORDING to a Bureau of Mines analysis of physical and chemical properties of Washington coke, issued in 1939, careful tests on representative samples demonstrated that cokes made from Washington coals are strong, resistant to shatter degradation, with high stability factors, and more resistant to breaking up into smaller pieces than eastern and southern coke. They were found to be fairly reactive, with ignition temperature ranges from 460 deg. to 570 deg. Their only undesirable feature is a rather high ash content.

The Wilkeson installation at Tacoma, includes a 17 oven Curran-Knowles by-product coke plant, involving an economical balance between coke, some additional coal, coke over gas, tars and oils. Provision has been made to double or even treble capacity as occasion warrants. Tacoma has the advantage of rail access over four transcontinental systems, and barge and deep water facilities on Puget Sound.

By March 1, President Morris Schnitzer believes that the new $1,250,000 electric furnace and rolling mill of Oregon Steel Rolling Mills, Inc., at Portland will be in operation. A second unit is to be built later in the year to double or even treble the capacity.

As in the case of similar electric furnaces at Seattle, Niles in the San Francisco district and in southern California, the Portland mill will operate entirely on scrap. Initially the mill will roll up to 6-in. structurals, merchant bars and rods. At the start the principal product will be filling bars, angles and channels for local shipyards and sub-contractors. The heart of the plant is a 75,000-ton Freyn continuous ingot heating furnace, 8 x 8-in. limits. Two O. T. Lectromelt furnaces are also being installed. In the rolling mill are three 20-in. breakdown stands, five 14-in. and two 9-in. The 20-in. stand is equipped with mechanical traveling tilting tables and is also arranged so that production can be run directly to a Morgan mechanical cooling bed, 198 ft. in length.

DUTCH STEELWORKS BOMBED: Two unescorted Bostons of the R.A.F. made a low level daylight attack on the Royal Dutch Blast Furnace and Steelworks at Velsen on Nov. 27, 1942. A bomb has burst on railway tracks serving a coke oven plant. *British Combine*



Research Fund Set Up by Foundrymen's Association

Chicago

• • • **The American Foundrymen's** Association has announced establishment of a foundation which will seek an initial fund of $1,000,000 for research and collateral projects. This will replace the association's old system of making individual solicitations of funds for each special project undertaken. Income from the foundation will total an estimated $25,000 to $30,000, and will annually be allocated to cover five year periods in order that continuing projects will be supported without interruption. A feature of the program, now being developed, is a system of matching grants, by which it is expected to increase the actual funds available each year by cooperating with related associations and interests.

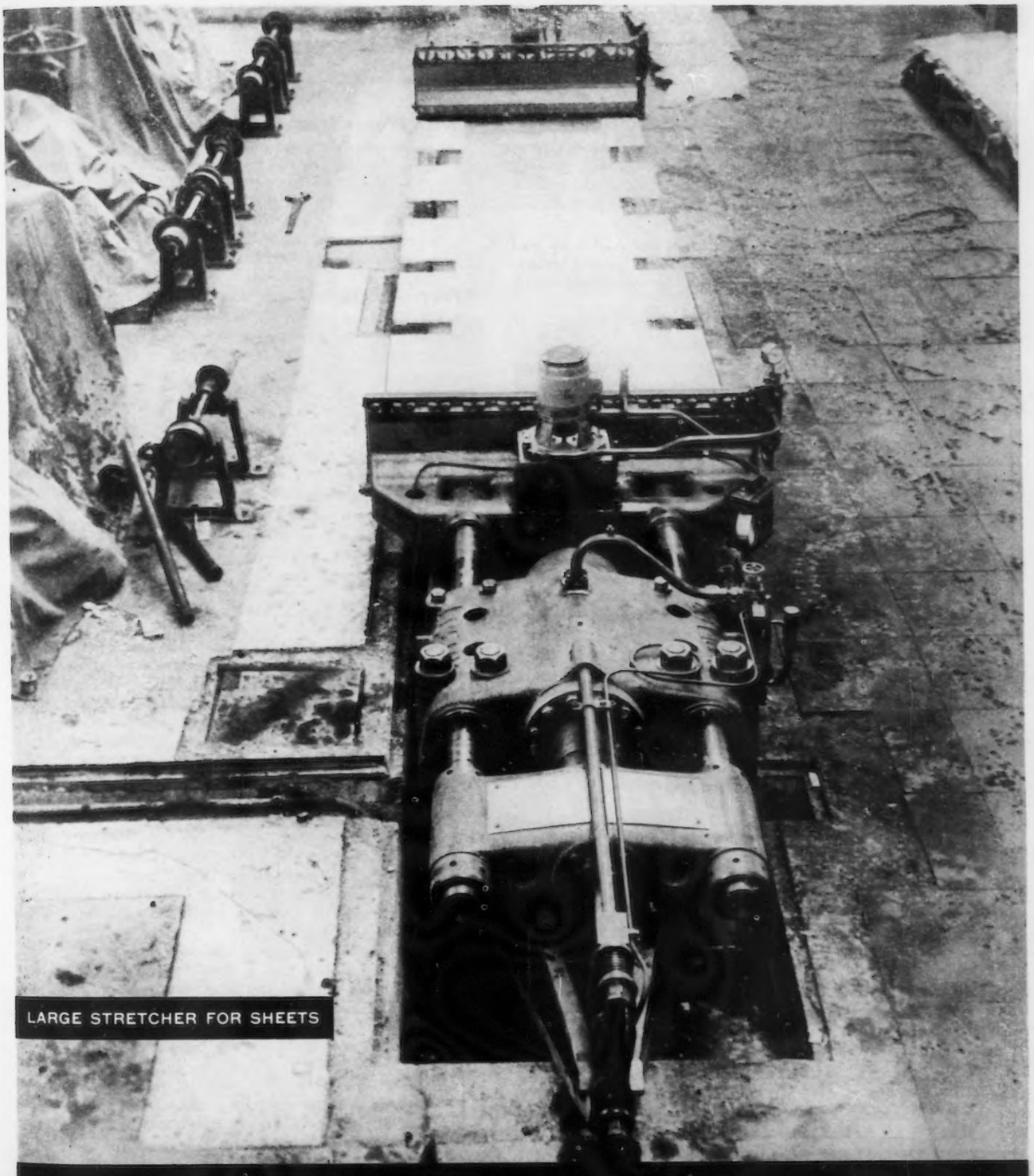
New Kaiser Blast Furnace In California Lighted Dec. 30

Los Angeles

• • • **The new** blast furnace at Fontana, east of here, was lighted Dec. 30 when Mrs. Henry J. Kaiser closed an electric switch. The furnace is a 1200-ton per day unit, using California iron ore and limestone and Utah coal.

In a speech at the ceremony, Henry J. Kaiser paid tribute to what he described as the steel industry's sportsmanship to which, he said, the Fontana plant was a monument. He said T. M. Girdler and C. M. White of Republic Steel Corp. had made available complete engineering plans. He gave thanks, too, to the Bethlehem Steel Co. and United States Steel Corp. for supplying and fabricating much essential material.

"A short-sighted, self-seeking industry would have fought this plant," said Mr. Kaiser.



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Fatigue Cracks

BY A. H. DIX

He Planted an Acorn

• • • *You now hold in your lap the finest, in our fond eyes, of the 4,524 issues your favorite family journal has ticked off since the day back in 1855 that John Williams invaded the Fourth Estate and planted an acorn.*

With decibel recorder concealed in our coat tails and left foot already poised in air, we stand in the wings, all set for a Nijinsky leap onstage to acknowledge with modest bows your acclaim.

Spotlight on Backstage

• • • Our wattmeter reveals that the mental energy consumed by the brains department in conceiving and executing this mighty work is sufficient to light Little Rock, the metropolis of Arkansas, for 27 days. But lest our editors get Klieg eyes we will switch the spotlight for a moment to those quiet but hardly introverted laborers in the vineyard, the members of the advertising staff.

It is a harmless conceit, fostered by publishers, that advertising comes unbidden, or at least on the slightest invitation, in the manner of housewives responding to a butter sale announcement. The truth is that the presence in this issue of useful information on practically every kind of equipment and material you employ is the result of an incredible amount of hard work on the part of the business department.

Our personal opinion has always been that the main value of the Annuals lies in the comprehensiveness of the information in the advertising pages. So we suggest that you guard this issue with particular care, for you will see from the words of our pres. and ed., John H. Van Deventer, on page 45, that it will probably be the last of the big issues for the duration. *C'est la guerre.*

He Put in His Thumb

• • • You can Jack Horner any part of it and come out with a plum. Our favorite is this one on page 53:

> To some the shock (of being told of the possible early exhaustion of Lake Superior ore) was somewhat akin to seeing Santa Claus in a zoot suit.

Free Pictures

. . . We have a few extra sets of the four-color illustrations that interlard this issue. If you want a set, send six cents in stamps, to pay postage, to us at 100 E. 42nd St., New York. First come, first served.

Aptronyms

• • • *The best aptronym of 1942 was the discovery that the H. K. Ferguson Company's authority on aerial photographic mapping is Sidney H. Birdseye.*

As a starter for the New Year we offer this: the chief of General Motors' photograph section is Floyd E. Filmer.

Brother in Misery

• • • The mistake for which we are sorriest is having called a stir bug with a drag a *trustee.* He is a *trusty,* as we were told by every general in this page's loyal army of 18 readers. This wound to our *amour propre* did not scar over until we read this sentence in the almost impeccable *New York Times,* "Prison officials said Johnston was assigned as a trustee."

Mr. Malaprop

. . . The oddest request was one received by a prominent member of the brains department, for "your photograph and some biological data about yourself."

Wise Words from Pug Impresario

The year's sagest observation was delivered by Mike Jacobs, the fight promoter. Mike was asked if he didn't believe that prize fights should be continued to help sustain public morale. "Now, wouldn't this be a hell of a country," Mike answered, "if we needed prize fights to make us want to win the war."

From A Plus to F

• • • The best speech we heard in 1942 was by William B. Ziff, author of "The Coming Battle of Germany," on the subject of his book. The worst was by Westbrook Pegler, on his contribution to infant mortality, the bumperless automobile campaign.

To Put It the Worst Way . . .

• • • The most agonized bit of English that met the public eye last year was the New York City Department of Water Supply, Gas and Electricity's dimout injunction and all-time pleonastic champion:

ILLUMINATION IS REQUIRED TO BE EXTINGUISHED BEFORE THESE PREMISES ARE CLOSED TO BUSINESS

Head of the Technical Hit Parade

• • • The article in greatest demand during 1942 was "Fine Tool Finish Increases Tool Life 2000 Per Cent," by Carl J. Wiberg and Wesley K. Heath, of Wright Aeronautical Corp., describing a development in cutting tool sharpening that has enabled Wright to make great increases in number of pieces produced per tool grind. The article is now the leading chapter in the 56-page reprint booklet, "How to Lengthen Cutting Tool Life."

Bells, Bells

• • • Strangest of the year's press releases came from the Ryan Aeronautical Co., which informed us that a two-room flight building on a Ryan auxiliary flight building was found missing one morning. Soldiers guarding the field said that some men uprooted the building, loaded it onto a truck, and drove away with it. Assuming the men had permission to take it, the soldiers did not interfere.

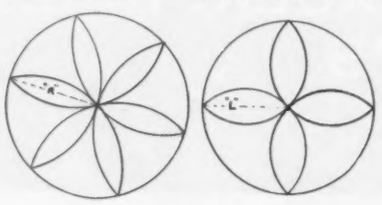
So far this is just run-of-mind press agentry. But wait. The building had a telephone in it. Ryan men searched every inch of the field where the building was located, but could not find the phone. Still, when the number was called, the phone rang. But nobody answered, it said in the press release.

Millions, She Said

• • • The most unconsciously funny shop remark we heard of during the year was made by a young lady employed as an inspector in an Akron, Ohio, plant. She said, according to the AP, that she was learning to read a micrometer "to make things come out right to the thousandth of an inch." "Marvelous!" said her companion. "How many thousandths do you suppose there are in an inch?" The micrometrist answered, "I don't know, but there must be millions."

Puzzle

Lt. Com. A. R. Simpson says par for this is 15 minutes, but a solution in 30 will get you a silver star on your report card.



The total area of the 6 petals in the left circle equals the total area of the 4 petals in the right circle. What is the ratio between "R" and "L", the lengths of the petals (which equal the radii of the circles)?

Compare the Fit of these two Threads!

Photomicrograph showing typical loose fit of ordinary machine screw in pre-tapped thread. Due to necessary manufacturing tolerances in screw and tapped hole diameters, a tight fit is seldom secured.

Photomicrograph showing snug, tight fit of Shakeproof Thread-Cutting Screw. Because each screw actually cuts its own thread, a perfect fit is always certain.

Both photomicrographs show enlargement of 20 diameters.

TYPE 1
Shakeproof Thread-Cutting Screw for all Metal Applications

This screw not only speeds assembly by eliminating tapping...it also provides a tighter, stronger fastening!

● Shakeproof Thread-Cutting Screws have two definite advantages that are important to the assembly of war equipment; they eliminate the need for taps and tapping—thus saving vital man-hours, and they provide a stronger, tighter fastening—thus assuring improved resistance to vibration. Try this better screw on your products. Write today for a handy kit of assorted testing samples!

The Slot Does It!

The end of the screw is slotted off-center to present an acute serrated cutting edge to the work. The chips produced are directed away from the cutting edge into the slot, which assures easy, fast driving.

SHAKEPROOF inc.
"Fastening Headquarters"

Distributor of Shakeproof Products Manufactured by ILLINOIS TOOL WORKS
2501 North Keeler Avenue, Chicago, Illinois
Plants at Chicago and Elgin, Illinois
In Canada: Canada Illinois Tools Ltd., Toronto, Ontario

SHAKEPROOF THREAD-CUTTING SCREWS

Dear Editor:

75 PER CENT IN WAR BONDS

Sir:

In your Dec. 17, 1942, issue, we were very much impressed with the picture of the young lady on page 74, showing what she is doing for the war effort with her deductions of 50 per cent of her earnings being put into war bonds.

We have a young lady who has been doing much better than that. Her husband is a Captain somewhere in the South Pacific. She has two small children which are taken care of by the sister while she works in our plant making gun parts, etc. Seventy-five per cent of each pay is put into war bonds—the remaining 25 per cent being given to the sister for the care of her children during working hours. She states she has more to work for than most people, because she wants her husband to get the equipment.

Our plant was primarily a tool and die shop, but now employs about 60 people — of which one-third are women. We have tried in all cases to hire women whose husbands were in the Armed Forces, and have been fairly successful in doing this. We find they make the better worker.

It is our belief that the young lady about whom we have explained should be given the proper credit.

J. E. MEDENDORP,
Manager
Economy Tool & Machine Co.,
Muskegon, Mich.

CRACKLESS PLASTICITY

Sir:

An article entitled, "Crackless Plasticity," by Professor H. F. Moore, of the University of Illinois, appeared in your issue of September 10, 1931.

I have written to Professor Moore and he informed me that I may possibly secure a copy of this article from you, as your magazine was the only one in which the article was published, and that he had none available himself.

Have you a copy available?

JOS. J. WHITE, JR.
Erie Forge Co.,
Erie, Pa.

• Our stock of back issues is incomplete. However, it is usually possible to obtain copies from one of the back number dealers. Our favorite in this field is H. W. Wilson Co., 960 University Ave., Bronx, N. Y. A copy of the issue wanted has been obtained and is being mailed to you.—Ed.

PLATED CUTTING TOOLS

Sir:

I would like to have a copy of THE IRON AGE of about a week or two ago. This issue contained an article on a new method of chrome plating on tools, to increase their life.

Hope that I have made this clear enough.

BERNARD GAGNON, AM 3/c
U. S. Naval Reserve Aviation Base,
Glenview, Ill.

• The article wanted is, "Tool Life Increased by Improved Chromium Plating Process," beginning on page 43 of the December 10 issue. Clipping is being sent.—Ed.

NE STEEL ANALYSIS

Sir:

We would like very much to get about six copies of page 149 of the November 5, 1942, issue of THE IRON AGE. This page shows the composition of new NE Steels.

H. A. GODDARD
Gulf Oil Corp.,
Pittsburgh

WELDING BRASS TO BRASS

Sir:

Could you recommend to us a book on oxyacetylene welding which would thoroughly cover the problems involved in welding brass to brass? For some time we have been performing an operation concerning the welding together of two brass hemispheres, and recently we have found a great number of pieces in which the brass is checking above the weld after having been welded. It is very possible that this is due to flaws in the brass itself, but having had no previous experience with this we are not certain.

We shall appreciate any advice which you may be able to give us.

GEORGE MATTHEWS
Union Steel Products Co.,
Albion, Mich.

• "Oxyacetylene Welding Brass and Bronze," issued by Linde Air Products Co., 30 E. 42nd St., New York, is about as complete a discussion on the subject as we know of. A brief reference to the welding of copper alloys is in the 1942 edition of the Welding Handbook published by the American Welding Society, 29 West 39th St., New York. We believe the price of this book is $5 to non-members.—Ed.

WELDING SCHOLARSHIP

Sir:

The response from the colleges to our announcement of the $6750 Annual Engineering Undergraduate Award and Scholarship Program has been commendatory. However, a few responses indicate that in certain instances it is assumed that student contestants must have had some previous connection with welding, either practical or academic, in their course of study. . .

The program is open to all students of engineering in *all* departments and the emphasis is "Design for Arc Welding" and not on the technique of welding. . .

A. F. DAVIS
James F. Lincoln Arc Welding Foundation,
Cleveland

OXYGEN CONCENTRATION

Sir:

In THE IRON AGE of Dec. 3, 1942, page 44, is an abstract of an article by two German metallurgists, called, "Oxygen Concentrations Linked with Acid Open Hearth Process." I would like to obtain the original source of this article.

JAMES C. VIGNOS,
Asst. to Executive Vice Pres.
Ohio Ferro Alloys Corp.,
Canton, Ohio

• Sorry we are unable to let you know the original source. The abstract was received from our English correspondent. When this information is obtained from him, we will let you know.—Ed.

SEVEN-DAY SCHEDULE

Sir:

Will you please send us several copies of the article, "How to Operate Seven Days a Week," which appeared in your December 25, 1941, issue.

L. A. GAGNE
Standard Piezo Co.,
Carlisle, Pa.

PLASTER MOLDS

Sir:

We would like to have two reprints of the article "Plaster Molds" by W. A. Phair in your October 9, 1941, issue if it is still available; also two reprints of the article on precision castings in the July 9, 1942, issue.

J. W. CRAPPLE,
Universal Castings Corp.,
Chicago

LIFE IN ENGLAND

Sir:

We would like to have permission to republish the letter from an English manufacturer that appeared in your issue of Nov. 19, 1942. It was called to our attention by a subscriber and we also think it gives an interesting picture of England at war and an accurate idea of the underlying thought there.

CLIFFORD J. NUHN,
Managing Editor
Poughkeepsie New Yorker,
Poughkeepsie, N. Y.

FEDERAL REGULATIONS BULLETIN

Sir:

The writer is anxious to learn the address of the publishers of The Federal Regulations Bulletin.

THEOBALD GUNTHER,
Salvage Manager
United States Rubber Co.,
Marion, Ohio

• The Federal Register, a daily publication, is issued by the Office of the Public Printer, Washington. In Rochester, N. Y., there is a firm called Federal Regulation Publishers, which we understand issues reports of OPA regulations, but not daily.—Ed.

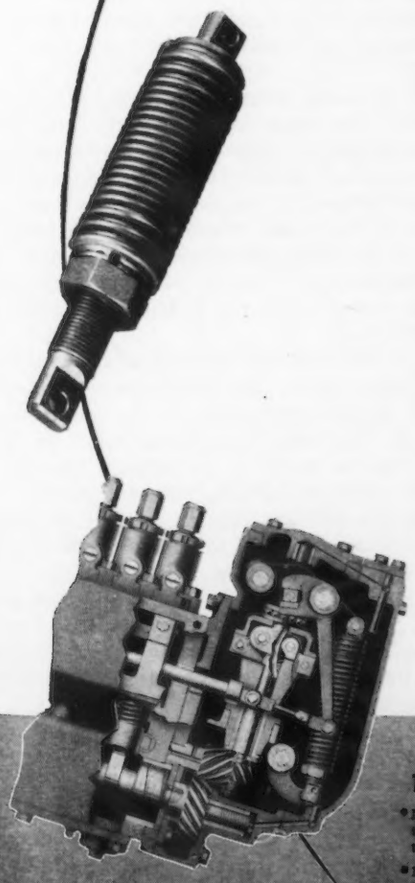
"CATERPILLAR" AND MUEHLHAUSEN SPRINGS

Can Take It!

Working continuously, "Caterpillar" built tractors are making minutes out of hours on hundreds of war jobs—uprooting huge stumps, plowing through mud, moving "mountains" of dry earth. Such service demands *instant, accurate* governor control of engine speeds.

Sealed within the governor unit, shown at lower left, is one of the many springs Muehlhausen makes for "Caterpillar." It is accurate to a fraction of an ounce, capable of withstanding heat and corrosion. Upon its performance depends the rapidity with which the "Caterpillar" engine responds to suddenly applied loads, and the careful regulation under varying loads. This precision and dependability are the results of close collaboration between Muehlhausen and customer engineers.

Muehlhausen can do the same for you, with springs of every type—compression, extension, torsion or flat—hot or cold formed. For quick action, wire or write today! MUEHLHAUSEN SPRING CORPORATION, 817 Michigan Ave., Logansport, Indiana.



FREE!
TWO NEW FOLDERS

- New Die Spring Bulletin illustrates, describes 206 sizes and types of die springs.
- New Armament Bulletin shows importance of springs for many types of war equipment.

MUEHLHAUSEN SPRINGS

EVERY TYPE AND SIZE

This Industrial Week . . .

- ***Year Starts With 99 Per Cent Ingot Rate***
- ***Industry's Order Books in a Healthy State***
- ***Bessemer Converters to Be Utilized More***
- ***National Production Scheduling Coming***
- ***Lack of Balance Still Constitutes Threat***

STARTING its third successive year of high pressure activity, the steel industry's ingot production this week is averaging 99 per cent, contrasted with 96.5 per cent one year ago and 97 per cent at the start of 1941. The gain is impressive considering the higher capacity prevailing now.

With much of the questionable tonnage cleared away, steel order books at the start of 1943 are much healthier than at any time since war began in Europe. Tonnages booked during December showed a gain over November, with steel plate orders very heavy. Rail orders have begun coming through. First quarter PRP requirements are exceptionally heavy, especially in alloy steel. The tool steel production picture is much better than at any time since the war started.

Tin plate mills, which operated at only 25 per cent of capacity during the fourth quarter of 1942, are expected to be producing 60 per cent during the first quarter of this year. The quota for the first quarter is around 700,000 tons. To be met in part by the utilization of new electrolytic and bonderizing units. In January at least four new electrolytic lines will be in operation, with four more scheduled to operate for the first time in February.

Rails and tin plate occupy prominent positions in the "essential civilian" category and mills are anxious to start rolling in order to ease the load later in 1943.

AS the year opens, a substantial gain is expected in the production of alloy steel, where demand at the close of 1942 was still months ahead of shipments, despite the fact alloy steel production rose to 13 per cent of the total steel production of 86,200,000 net tons. New electric steel capacity and an increase in alloy steel output by open hearth furnaces will take place in 1943. Steel companies which have not made alloy steel previously in open hearths are preparing to do so at the request of WPB.

Additional production of alloy steel may add to the strain on finishing facilities. Rolling mill capacity which previously only handled carbon steel may be adapted to alloy steel.

Like the transformation of the continuous strip mills which became plate mills in 1942, this year will see structural mills switch to the rolling of large rounds needed in the armament program. Structural steel demand at present is at a low ebb while large round mills are booked far beyond capacity. The new year also will see the Pacific Coast become increasingly important in the steel picture. Never has there been so marked a change in the raw material production facilities for heavy industry west of the Rocky Mountains and on the Pacific Coast than during the past 12 months, nearing a climax now.

Bessemer converters will be utilized to a greater extent in 1943. During 1942 there was an upward trend in the utilization of blown metal from bessemer converters. The trend started a few years ago in the using of bessemer blown metal in duplexing, synthetic scrap making and partial duplexing. Committees are expected to report soon on the greater utilization of bessemer steel in order to ease the load on open hearths.

TWO of the problems which have been ever-present since war began can be expected to remain potentially dangerous this year—the scrap supply situation and the lack of balance in the armament program. Scrap collections were held up last week in some areas due to flood waters and mills fell back on their inventories. Whether stock piles will last through the winter depends considerably on weather conditions; but some experts look for a dearth of scrap in late February.

War leaders still are trying to achieve balanced production and they may be nearer to this goal than ever before, barring radical changes in the manner of fighting the war. This week's announcement of 1943 goals which compared to 1942 are altered in respect to necessary quantities of certain war equipment, culminates months of study and appears to be a heartening development. Unquestionably the unbalances which existed in 1942 deterred American front line forces.

With the tank, truck, artillery and ammunition programs trimmed, more emphasis will be placed on heavy bombing planes, merchant ships, naval combat and escort vessels. Probably escort ships are most important of all at the start of 1943.

At Washington a decision has been reached that production scheduling on a national scale is the best step that can be taken now toward winning the war. The kind of scheduling that industry may expect has not been spelled out yet by the war agencies, although the principal of scheduling is adopted by all government agencies concerned in the new Controlled Materials Plan.

Starting with the individual plant, schedules will be

perfected next for industrial areas and finally all of the information obtainable on end products, raw materials and fabricating capacity will be incorporated in an all-inclusive schedule of national production. Interlocking schedules must be drawn up, with the timing of every part, assembly and sub-assembly recorded and built into the master time interval schedule.

BEFORE scheduling can be done, the following information must be well known: The type, number and varieties of weapons to be made and when delivery is desired; the kinds, specifications and amounts of raw and fabricated materials required to meet the programs together with estimates of the amounts of such material available (production time factors), and the end and component capacity of every factory within every program.

The seriousness of the war situation can be expected to bring new standardization programs. For instance, the number and types of steel bars rolled probably will be reduced.

The fact that CMP has not proceeded more rapidly is a source of chagrin to many executives who feel that it may not be possible to get the plan into full operation by July. During the second quarter of 1943 only a very small section of industry may be actually operating under CMP.

The mechanics of operation under the new Controlled Materials Plan were scheduled to be outlined this week with issuance of Regulation No. 1. Inventory restrictions were announced Monday of this week. An order fixing the position of steel warehouses under the plan is expected to be issued soon. Reporting forms and repair and maintenance regulations are needed,

Requests for bills of materials by the Army, Navy and other agencies have been fewer than expected, indicating that similar previously obtained data are being employed by the agencies instead of new bills of material. Completion of the B-1 and B-2 lists has been achieved, totaling several thousand items. Any product containing controlled materials (aluminum, copper and steel) which is not included in the B lists will be an A product.

Already CMP has created a manpower problem with some companies. One medium sized Midwest company reported it spent 2200 man hours trying to unravel the plan, while another plant spent 1600 hr. Both firms complained that after spending so much time they were stymied by WPB's inability to give them authoritative answers to key questions.

IN view of the doubling of the aircraft program for 1943, compared to 1942, some machine tool makers and dealers expect substantial orders for production tools. So far, however, there has not been any recent large scale machine tool buying from the aircraft industry. There are numerous new airplane plants coming into production soon, but the tooling for these has either been installed or at least ordered.

The policy statement issued at the start of this week by WPB, Army and Navy establishes several considerations to be applied in curtailment of schedules as they affect the individual contract. Considerations will include: (1) Prime contractors will be expected not to cut sub-contractors schedule by a greater percentage than the cut in the prime contract schedule, where practical; (2) where cuts are necessary, it will be the policy to continue operation of the most efficient operators as regards material and labor use; (3) effect on the labor market will be considered. Where labor is needed in an area, it is likely that cuts in schedules will be used as a device to release labor.

Despite the handicap of one of its worst floods, Pittsburgh steel ingot operations jumped one and a half points to 101.5 per cent while in Detroit output increased five points to 104.5 per cent from last week's revised rate of 99.5. The only other district showing a gain in ingot production was the Eastern area, up 10 points to 105 per cent. Dropping two points, the rate of steel melting in Chicago was down to 100 per cent. In Cleveland output fell four points to 94 per cent and in Buffalo it was down two points to 104.5 per cent. Cincinnati production sagged six points to 99 per cent. Philadelphia reports a one-point drop in schedule rates to 91 per cent.

Steel Executives Praise Employees For Exceptional Work During Flood

• • • Steel executives at Pittsburgh, Wheeling and Youngstown and other centers were loud in their praise of the exceptional job done by steel workers in preparing for flood conditions and in working night and day during the high waters of the past week and for a continuation of this performance in bringing operations back to normal in short order. Despite high waters in one plant, not one single motor was inundated due to foresightedness of workmen and management. In other cases debris and mud was cleared away after the waters receded and operations resumed much sooner than had been expected. Outstanding factor in the recent emergency was the lack of hysteria and the well organized and carried out plans for preventative maintenance before the crest was reached and rapid repairs and clean up afterwards.

The Iron Age

Steel Ingot Production by Districts Per Cent of Capacity

Week of	Pittsburgh	Chicago	Youngstown	Philadelphia	Cleveland	Buffalo	Wheeling	South	Detroit	S.Ohio River	West	St. Louis	East	Aggregate
December 31	100.0	102.0	100.5	92.0	98.0	106.5	86.0	98.5	99.5*	105.0	102.0	107.0	95.0	99.5
January 7	101.5	100.0	101.0	91.0	94.0	104.5	86.0	98.5	104.5	99.0	102.0	107.0	105.0	99.0

* Revised

Sub Propeller Shafts Needed Quickly!

Story of How Ryerson Ingenuity Saved Five Weeks

URGENTLY needed at a distant shipyard were fourteen forged submarine propeller shafts that must pass Navy specifications.

Forgings were specified, but none could be secured in time.

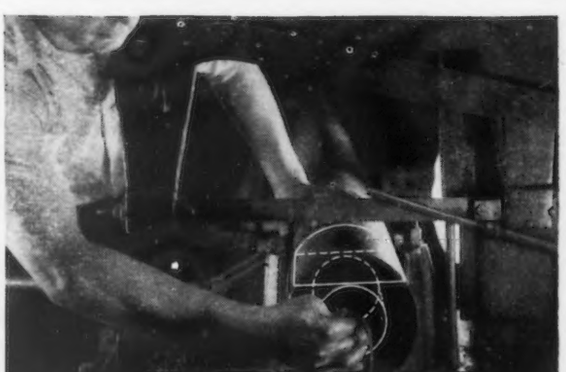
Quickly available in Ryerson stocks were cold rolled bars—the right size—but in five different analyses.

Navy Inspectors were skeptical. Could Ryerson heat-treat and assure uniform physicals—also furnish pull tests for each bar? Well, no; because the piece left after the bars were cut to the needed length, would be too short to make a standard 6″ test sample. A delay of five weeks loomed ahead. . . .

Then Ryerson metallurgists found a way: Inquiry revealed that the shafts were to be machined down at each end for a distance of 7″. So, why not cut a piece from the side of each bar, *before machining*—enough for all tests yet leaving sufficient stock for machining to size? The idea worked perfectly.

The data charts always furnished with Ryerson Certified Steels provided the exact analysis of each bar and assured proper heat-treatment. A few minutes hacksaw work yielded the necessary test samples . . . and all fourteen bars passed the rigid Navy Inspection with flying colors.

Ryerson ingenuity has helped many manufacturers in solving production problems—has also cut ultimate delivery time from months to days. Ryerson engineers and metallurgists, backed by a century of service to the nation, are ready to work with you in accordance with WPB plan in making the most of all available steel.



Cutting 6″ test pieces from side of bar without affecting length.

JOSEPH T. RYERSON & SON, INC., Chicago · Milwaukee · St. Louis Cincinnati · Detroit · Cleveland · Buffalo · Boston · Philadelphia · Jersey City

RYERSON STEEL-SERVICE

News of Industry

War Output Double That of 1942 Is New Goal in U. S. for 1943

• • • **War output** double that of 1942 is the goal for 1943 in the United States. Cuts have been made in the tank, artillery, ammunition and motor vehicle programs but the average percentage of curtailment is small when compared to the whole armament program.

Here are major features of the 1943 program as set forth by authorities at the start of this week:

"About twice the number and about four times the weight of planes built in 1942, with emphasis continued on bombers designed to carry the maximum destruction to the enemy fighting forces and industrial centers.

"More than twice the merchant ship tonnage of 1942 in order to assure delivery of critically needed supplies to our ground and air forces and those of our Allies.

"A considerable increase in the naval escort vessel program in order to afford protection for merchant shipping operating on supply lines to all corners of the globe.

"More naval combat vessels so that our sea power will be able to carry the fight to enemy fleets and operating bases."

The items in these component programs, the statement said, comprised for the most part those that are difficult to make and require large quantities of material, parts, skilled manpower and special facilities.

In its broad aspects the 1943 production program has been adjusted for the first quarter to about 19,600,000 tons of carbon steel; 3,400,000 ingot tons of alloy steel; 700,000 tons of copper and about 560,000,000 pounds of aluminum. By the last quarter of 1943 the supply will be substantially increased and a corresponding increase in the program will be possible.

The program is designed to keep pace with the ever-changing requirements of modern warfare. If war takes a turn in which the demands are more urgent in one category than in another, upward revisions must be accomplished at the expense of downward revisions.

The policy statement by WPB, Army and Navy establishes several considerations to be applied in curtailment of schedules as they affect the individual contract. Considerations will include:

1. Prime contractors will be expected not to cut sub-contractors' schedules by a greater percentage than the cut in the prime contract schedule, where practical.

2. Where cuts are necessary, it will be the policy to continue operation of the most efficient operators as regards material and labor use.

3. Effect on the labor market will be considered. Where labor is needed in an area, it is likely that cuts in schedules will be used as a device to release labor.

Donald M. Nelson, chairman of the War Production Board, has set the placing of at least $1,000,000,000 in contracts as the goal of the Smaller War Plants Corp. in 1943. The directorate may be reshuffled for greater efficiency.

Other WPB officials are convinced that the agency, if it uses determinedly the broad powers given it by Congress, can place up to $4,000,000,000 worth of contracts, equaling the value of a prosperous year's output of the entire automotive industry in peace time.

Informed WPB sources reported that two or more of the five corporation directorships probably will change hands.

Army Appoints Skinner To Balance WPB's Wilson

Washington

• • • **Charles E. Wilson,** General Electric president and No. 1 production scheduling man for WPB, now it appears has an opposite number in the War Department. Sherrod E. Skinner, General Motors vice-president, has been appointed Director of Production Scheduling, Army Services of Supply, it was announced recently. Mr. Skinner, it is understood, will have complete control of all War Department production scheduling.

Batcheller Calls for Unslackened Effort

• • • **Continued and** unslackened efforts must be made by the steel industry to meet 1943 production goals, Hiland G. Batcheller, director of the steel division, said Jan. 1.

Pointing to Chairman Nelson's recent report on the status of the expansion program, Mr. Batcheller warned that the peak capacity of 97,115,000 tons of steel ingots will be achieved on schedule only if management and labor, from the mines through the mills, work unceasingly to finish each part of the program on schedule, and, if possible, ahead of schedule.

"The steel industry has just passed through a year in which vast demands were made of it. By and large, it met those demands with a production of 86,000,000 tons of ingots. And at the end of the year, the industry was operating at an annual rate of 89,000,000 tons," Mr. Batcheller said.

"The steel division has promised the WPB that it will 'deliver' even more steel next year. The fulfillment of that promise is dependent on every member of the steel industry itself.

"If ore production is going to hit the annual rate of 134,000,000 tons next year; if our open hearths are going to produce at the annual rate of 84,000,000 tons; if we are going to reach a peak of 6,000,000 tons of electric furnace capacity—if we are going to meet all our goals, each individual working on any part of the huge expansion program must do his bit to get it finished—and finished quickly.

"And of course, the sooner we finish the expansion job, the quicker we'll beat the Axis. For so far, this has been a war of steel—steel for us and our Allies—steel for tanks, for guns, for planes, and a multitude of other things."

Mr. Batcheller pointed out that 1943 is the key year as far as the steel expansion program is concerned.

"Most of the groundwork was laid in 1942, and a good part of the additional facilities were brought in," Mr. Batcheller said.

Revisions to The Iron Age Priorities Guide

• • • The following data, together with all intermediate weekly revisions in THE IRON AGE, should be added to THE IRON AGE Priorities Guide published with the issue of October 8 to bring the Guide up to date.

Included are changes through Dec. 31, 1942.

Priorities Regulations:

No. 1...Amendment (12-30-42) permits sales under certain circumstances of material bought with preference ratings.

"M" Orders:

M-9-b...Amended order brings copper clad steel scrap under full allocation control (12-23-42).

M-9-c...Amended order extends restrictions on use of copper (12-28-42).

M-9-c-3...Amended order releases frozen stocks of bronze powder (12-28-42).

M-15-b-1...Revised order sets up complete specifications for manufacture of 31 classes of products (12-28-42).

M-23-a...Amended order brings special directives into framework of order (12-26-42).

M-39...Amendment No. 1 to amended order (12-28-42) permits use of cobalt in driers.

M-104...Amended order restricts materials and commodities which may be packed in glass containers using metal closures (12-26-42).

M-126...Amendment (12-26-42) revises military exemption list.

M-1-d...Order extended indefinitely (12-31-42).

M-1-g...Order extended indefinitely (12-31-42).

M-2-b...Amended order simplifies original magnesium allocation order (12-31-42).

M-21...Amended order permits sale of fireplace dampers or grates weighing 30 lb. or less without preference ratings (12-29 42).

M-21-b...Amended order permits a warehouse to exceed its quota for the first quarter of 1943, provided that it keeps within its total allotment for the period Jan. 1, 1942, through Mar. 31, 1943 (12-31-42).

"P" Orders:

P-88...Amendment No. 2 (12-23-42) brings street railway systems and trolley bus lines within the scope of regulations governing steam railroads.

P-126...Amended order continues high preference ratings for material needed for emergency servicing of refrigerating and air conditioning machinery and equipment until revoked (12-31-42).

P-134...Order assigns high preference ratings for repair and maintenance materials needed by small non-ferrous metal mills which do not operate under PRP (12-31-42).

"L" Orders:

L-41-c...Supplementary order removes from provisions of order necessary logging camp construction (12-23-42).

L-73...Amended order stops production of certain office supplies (12-28-42).

L-42...Revised schedule imposes further restrictions on use of metal in the manufacture of plumbing fixtures (12-30-42).

L-161...Amendment (12-31-42) tightens restrictions on sales of electric fuses by manufacturers.

L-235...Order standardizes production of air field and seadrome lighting equipment (12-28-42).

"E" Orders:

E-1-b...Amended order provides that preference ratings no longer have any effect on delivery schedules for the 75 per cent of machine tool production allotted to Service Purchasers (12-29-42).

This Week's Priorities and Prices

Copper clad steel scrap is brought under full allocation control by order M-9-b as amended Dec. 23. (T-1459)

Bronze powder and bronze powder products have been released for uses which previously had been prohibited, under order M-9-c-3. (T-1469)

Completion of the B-1 and B-2 lists of the Controlled Materials Plan has been announced. These lists are subject to change. (WPB-2291)

Lightweight steel fireplace grate maximum prices are established in Order No. 107 under Maximum Price Regulation No. 188. (OPA-T-458)

New machine tool dealers may apply to their own sales any specific price adjustments that have been made to their manufacturer's ceiling prices, according to Amendment No. 22 to Revised Price Schedule No. 67, effective Dec. 31. (OPA-T-447)

■ ■ ■

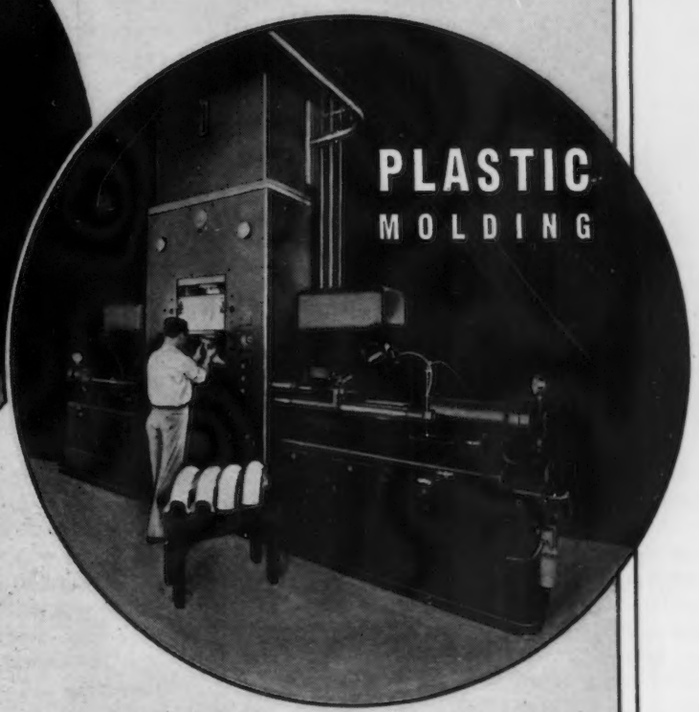
For copies of above announcements address Office of War Information, Washington, giving announcement number as shown in parentheses after each paragraph.

Inventory Control Imposed Over CMP Controlled Materials

• • • **Inventory control** was imposed over CMP controlled materials, steel, copper and aluminum, by issuance of CMP Regulation No. 2 by WPB on Monday. The regulation provides that manufacturers may maintain a 60-day maximum inventory of all products in the steel, copper and aluminum material lists incorporated in the CMP plan.

The 60-day maximum applies both to production and maintenance and repair and to the products in the CMP list's inventory. An example of how this works is that a manufacturers say has an excessive inventory but is short in particular stocks. The regulation may bring those short items up to the 60-day maximum or to a proper working level. The order does not apply to any material in process.

METAL SPECIALTY



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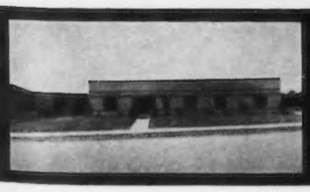
Metal Specialty's plants are equipped to render you complete service in the fabrication of all metal parts, and in plastic injection molding up through 18 ounces per shot. Along with 850-ton self-contained hydraulic presses for metal working, Metal Specialty has one of the four 18-36-ounce capacity injection presses for custom molding together with full complementary equipment.

ASSEMBLED JOBS

PRESSED METAL TO ORDER

THE PLANT AT CINCINNATI, OHIO

THE PLANT AT RICHMOND, IND.



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METAL SPECIALTY Co.

MAIN OFFICE AND PLANT • ESTE AVENUE • CINCINNATI, OHIO

MACHINE TOOLS

. . . *Sales, Inquiries and Market News*

Ordering by Aircraft Plants Not Up to Expectations

Cleveland

• • • **With the plane production** quota for 1943 set at 100,000 ships of all types, more than double the 49,000 plane output of the country this year, there is a great deal of consideration as to how such a program can be met. In November, with the announcement of C. E. Wilson's Aircraft Production Board, a division under the WPB, emphasis was placed on plane production, with the consequent curtailment of production of other war goods.

Immediately there was a wholesale cancellation of orders by producers of war materials for machine tools. As time passed this cancellation "mania" tapered off until at the present time the tone of letters from prospective purchasers of machine tools to dealers is one of "How much would it cost *if* such and such a job is cancelled as of today?" However, the cancellation itself often never appears.

On the other hand, there has not as yet been any concentrated ordering of machine tools by manufacturers of aircraft, aircraft parts, sub-assemblies, or the myriad equipment and gadgets that go into a completed airplane. Obviously, there are many new airplane plants coming into production, such as those at Atlanta, Cleveland, Chicago, and Wichita, Kansas, and the tooling for these has either been installed or is at least ordered.

To meet the production schedules of these plants it would seem reasonable that parts, equipment, and sub-assembly manufacturers will have to step up their production and to do this, above what was produced this year, it also seems likely that more machine tools and possibly more space will be needed. Strangely enough, there have been no large expansion programs along these lines announced recently.

Machine tool manufacturers and dealers expect the aircraft industry to come in shortly for substantial quantities of production tools. However, except for occasional orders for one or two machines of a given type, this buying spree has not started.

BUILDING BELLY-COVERING: Trainees are building a belly-covering for a transport plane at the Consolidated plant in Fort Worth, Texas.

International

Urgency Standings to Set Delivery Schedules

• • • **Preference ratings** no longer have any affect on delivery schedules for the 75 per cent of machine tool production allotted to Service Purchasers. Under the terms of General Preference Order E-1-b as amended Dec. 30 by the WPB Director General for Operations delivery schedules are now determined by the urgency standing of the Service Purchaser.

"Service Purchasers" are the Army, Navy, Maritime Commission, or their contractors or sub-contractors. Urgency standing is established by the Numerical Master Preference List as amended from time to time. The list is confidential.

Heretofore, preference ratings were used in scheduling deliveries to Service Purchasers who had no urgency standings. Under the order as amended, orders from Service Purchasers without urgency standings are to be scheduled according to the date of receipt of a copy of the purchaser's Preference Rating Certificate.

Delivery schedules for the 25 per cent of machine tool production allotted to foreign and other non-Service Purchasers continue to be governed by preference ratings. Where the preference ratings on two or more efficient orders are the same, the machine tool builder is directed to give preference to the order for which he first received a copy of the purchaser's preference rating certificate.

The changes made affect only those purchase orders received after Dec. 25, 1942. Delivery schedules already established for purchase orders received before that date do not have to be changed.

Niles-Bement-Pond Gives Workers $1 Million Bonus

• • • **Employees of** Pratt & Whitney Division, Niles - Bement - Pond Co., West Hartford, were given Christmas bonuses totaling $1,000,000. Each worker received a gift equal to 5 per cent of his total earnings for the year.

Come to "MAGNETIC HEADQUARTERS"

Dings High Intensity Lifting Magnet handling five 2,000 lb. castings.

FOR FASTER, MORE EFFICIENT HANDLING OF THESE JOBS:

Separation of Ferrous and Non-Ferrous Scrap—Dings builds a complete line of magnetic pulleys, pulley type separators, drum type separators and agitating type separators for handling *all* classes of scrap.

Conditioning Foundry Sand—Pulleys, pulley type separators and drums to remove all iron. Sand, hot from the shakeout floor, can be handled on Dings equipment designed to withstand high temperatures.

Reclaiming Iron from Slag—An efficient, high capacity output can be secured with Dings equipment.

Handling Metal—Scrap, castings, plates, metal flasks, pipe, etc., can be handled faster and easier with Dings Lifting Magnets.

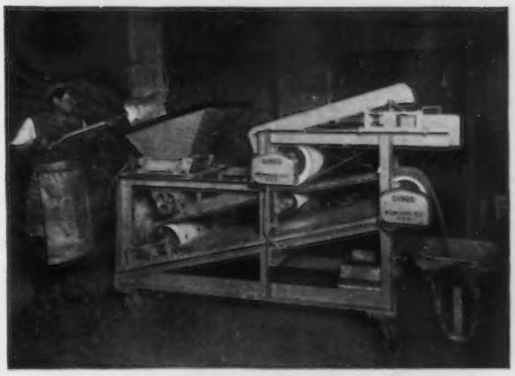
Screwdown on Mill Stands—This and other remote control clutch jobs are naturals for Dings Magnetic Clutches.

Write today for literature

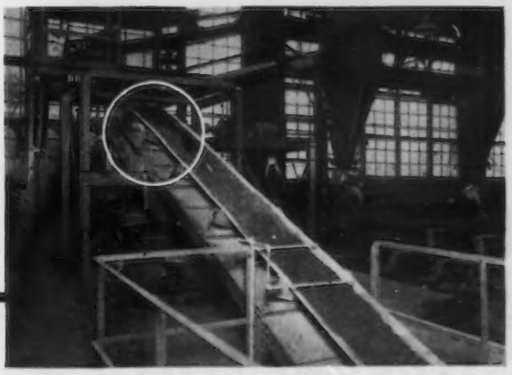
DINGS MAGNETIC SEPARATOR CO.
516 East Smith Street • Milwaukee, Wisconsin

Dings MAGNETIC SEPARATION HIGH INTENSITY

Pulley Type Separator for removing iron from foundry sand.



Dual Pulley Type Separator with "selective separation" for non-ferrous scrap.



High Intensity Pulley, installed in sand-handling system of large foundry.

E is for Excellence

(CONTINUED FROM PAGE 71)

Standard Propeller Division, East Hartford, Conn.

United Elastic Corp., Easthampton, Mass.

United Engineering & Foundry Co. (105 MM Howitzer Plans), Youngstown, Ohio

United Shoe Machinery Corp., Beverly, Mass.

United Specialties Co., Mitchell Division, Philadelphia

U. S. Coast Guard (Machine Shop), Curtis Bay, Md.

United States Rubber Co., Ordnance Plant, Des Moines, Ia.

United Wallpaper Factories, Inc., Chicago

United Wire & Supply Corp., Providence, R. I.

Universal Boring Machine Co., Hudson, Mass.

Universal Building Products Corp., Dallas, Texas

Universal Unit Power Shovel Corp., Milwaukee

Uxbridge Worsted Co., Uxbridge, Mass.

V

Vanadium Corp. of America, Bridgeville, Pa.

Veeder-Root, Inc., Hartford, Conn.

Vendo Company, Kansas City, Mo.

Victor Chemical Co., Mt. Pleasant, Tenn.

Victory Plastic Co., Hudson, Mass.

Vilter Mfg. Co., Milwaukee

Virginia Bridge Co., Roanoke, Va.

Virginia Engineering Co., Inc., Norfolk, Va.

Vultee Aircraft, Inc., Vultee Field, Cal.

W

Ward Leonard Electric Co., Mount Vernon, N. Y.

Watertown Arsenal, Watertown, Mass.

Watervliet Arsenal, Watervliet, N. Y.

Waverly Tool Co., Irvington, N. J.

Weber Show Case & Fixture Co., Inc., Los Angeles

West Point Mfg. Co., Langdale and Shawmut, Ala.

Western Cartridge Co., East Alton, Ill.

Western Electric Co., New York

Westinghouse Electric & Mfg. Co., Radio Division, Baltimore

Westinghouse Electric & Mfg. Co., East Pittsburgh, Essington, Philadelphia and Sharon, Pa., Newark

Weston Electrical Instrument Corp., Newark

Wheeling Corrugating Co., Wheeling Plant, Wheeling, W. Va.

S. S. White Dental Mfg. Co., Staten Island, N. Y.

White Motor Company, Cleveland

Whittington Pump & Engineering Co., Indianapolis

Wigton-Abbot Corp., Mahoney-Troast Construction Co., Bayonne, N. J.

Williams Oil-O-Matic Heating Corp., Bloomington, Ill.

Wilton Woolen Co., Wilton, Me.

J. H. Winn's Sons, Winchester, Mass.

Winthrop Chemical Co., Inc., New York

Winter Weiss Co., Denver, Colo.

Wisconsin Bridge & Iron Co., Milwaukee

T. H. Wood Co., Inc., South Coventry, Conn.

John Wood Mfg. Co., Muskegon, Mich.

Woodward Governor Co., Rockford, Ill.

Woodworth Co., N. A., Ferndale, Mich.

Worthington Pump & Machinery Corp., Holyoke, Mass.

Worumbo Mfg. Co., Lisbon Falls, Me.

Wright Aeronautical Corp. (Cincinnati Plant), Lockland, Ohio, also Paterson, N. J.

Wright Machine Co., Worcester, Mass.

Wyman-Gordon Co., Harvey, Ill., Worcester, Mass.

Y

York-Hoover Body Corp., Body Division, York, Pa.

York Safe & Lock Co., York, Pa.

Youngstown Welding & Engineering Co., Youngstown

Z

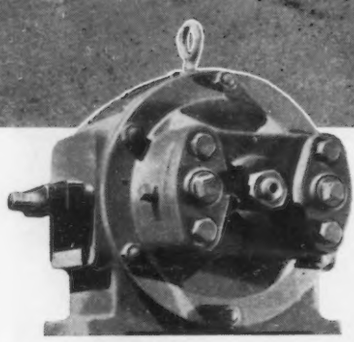
Zenith Optical Co., Huntington, W. Va.

Zenith Radio Corp., Chicago

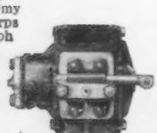
IT'S A CINCH IN A TANK!

Hele-Shaw Fluid Power also simplifies reversing. Takes jars and jerks out of machines.

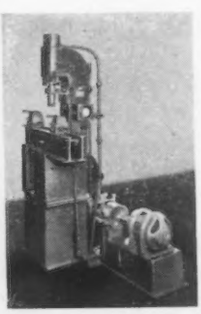
Are you designing, building, or operating a machine using a motion that must be reversed? If you can do the job hydraulically and you want to make the reversal smooth as silk, figure on the possibility of using Hele-Shaw Fluid Power. Hele-Shaw Fluid Power is generated in a Hele-Shaw Pump. The pump develops high pressure in an oil medium. Rotary, radial, multiple cylinders smooth out the pulse of the oil. Several types of Hele-Shaw controls are available which reverse the direction of the flow of oil instantly at the pump. With a Hele-Shaw Pump and a Hele-Shaw Control a face grinder manufacturer has eliminated reversing valves, taken the jerks and jars out of his table drive. Our catalog tells many more advantages of Fluid Power. Let us send you a copy.



Official U. S. Army Signal Corps Photograph



Hele-Shaw Pump with Type D Regulator — This, one of many Hele-Shaw regulators, reverses the direction of flow, gives any rate of discharge from zero to maximum in either direction independently of pressure.



20-TON RIFLE BARREL STRAIGHTENER, manufactured by the Watson-Stillman Company. Operated by a Hele-Shaw Pump equipped with a Type D Control. →

THE **Hele-Shaw** *Fluid Power Pump*

OTHER A-E-CO PRODUCTS: TAYLOR STOKERS, MARINE DECK AUXILIARIES, LO-HED HOISTS

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They get around, these Square D Field Engineers. They're digging into wartime electrical control and distribution problems every day—working with plants of *every size and kind.* They study methods and applications with the idea of simplifying new jobs or doing old ones better. That is vitally important work during these days when the production front is facing its greatest test. It is equally important in planning *now* for speedy conversion the day peace comes.

If you have a problem involving electrical control or distribution, call in the nearest Square D Field Engineer. Backing him up in every Square D plant, are design and engineering specialists with complete research and testing laboratories at their command.

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★ PANELBOARDS ★ MULTI-BREAKERS ★ WELDING CONTROL
MILITARY ★ AIRCRAFT ★ MARINE ELECTRICAL CONTROL

Record Ore Movement

(CONTINUED FROM PAGE 92)

growing scarcity of high grade ores in the upper lake regions. Deposits that have been so rich in the past are becoming depleted, and at war production rates, many of the known reserves in the Lake Superior district may be exhausted in 1950. In a report to the War Production Board, E. W. Davis, director of the Mines Experiment Station, of the University of Minnesota, has pointed out that there are considerable reserves of lower grade ores, both of a magnetic and non-magnetic type, and it will be these leaner ores that industry will have to fall back on in a few years. Table I shows Mr. Davis' estimates of high grade ore reserves and concentrates available, while Table II shows the estimated Taconite lower grade ore reserves.

Ore Concentration

As yet, aside from the concentrating of the richer magnetic ores, not much has been accomplished in the utilization of these leaner ores. Experiments and research are being carried on by most of the major mine owners to utilize these ores, and this work is being encouraged to a great extent by the State of Minnesota, which is trying by all possible means to protect its position of supremacy insofar as supplying the country with iron ore is concerned.

In the past, there has been a 2 per cent per ton tax on all iron ore reserves in Minnesota, which is paid by the mine operators. However, this tax has been suspended by act of state legislature on the Taconite and other lean ore reserves so as to encourage their development. As can be seen from Table II, the Taconite and lean ore reserves in Minnesota are quite substantial, and, as Mr. Davis estimates, should be sufficient for an inestimable period of high operations of the steel industry if properly utilized.

From Table I, it can be seen that reserves of high grade ores are limited to slightly more than a billion tons, or about 10 years' supply. Of this, some 5 years' supply exists in both open pit and underground reserves and the balance is made up of concentrates of low-grade ores. The concentrates produced in this area are those of low grade open pit ore that is too poor to be shipped "as is" to the furnaces, but is of the proper physical structure and chemical analysis to respond to known and accepted processing methods.

▼ ▼ ▼

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Physical soundness, correct hardness, size accuracy, and sphericity are guaranteed unconditionally in all Strom Balls.

Other types of balls—*stainless steel, monel, brass* and *bronze*—are also available in all standard sizes. Write for catalog and prices.

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The largest independent and exclusive Metal Ball Manufacturer

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ARMY E NAVY
Awarded Dec. 7, 1942

Pig Iron Establishes New Record

(CONTINUED FROM PAGE 95)

this center added 616,616 tons to its 1941 output of 12,113,577 tons. Since its capacity increased by 451,260 tons during the year, the relative tonnage rise over 1941 was 165,256 tons. Establishing new records for production and repairs month after month was Carnegie-Illinois' Gary Works which broke its own output record three times and set a new record of 21 days, 3 hr. and 50 min. for relining a furnace from the mantle up. A new furnace was blown in at Indiana Harbor by the Inland Steel Co. on Nov. 24. American Steel & Wire Co. acquired one of the dispossessed Joliet furnaces for its Duluth Works. Existing furnaces whose capacities were enlarged during the year include two Interlake Iron Co. units by 40,000 and 60,000 tons and one Gary furnace of Carnegie-Illinois by 144,000 tons. Three furnaces in the Chicago district had their capacities increased by the use of sintered ore. Inland at Indiana Harbor added 73,000 tons to its annual capacity; Youngstown Sheet & Tube at the same locality increased its by 62,000, and Interlake, Chicago, will be able to produce 33,000 more tons a year through sintering.

Smallest producer of pig iron was the Western district which operated at 94.3 per cent of capacity, the country's low, making 845,905 tons. Although this represents a rise of 47,777 tons, capacity available during 1942 was augmented by 139,685 tons. One of the only highlights of the year in this district was the re-erection of one of the Joliet furnaces. Kaiser's 432,000-ton-a-year blast furnace at Fontana, Cal., was scheduled to go into operation in December but is now expected to be completed in 1943.

A number of factors contributed to the rise of pig iron capacity by 3,790,365 tons to 60,472,565 tons annually. These include new furnaces, restoration of abandoned furnaces, enlargement of existing facilities, thinner linings and the use of sintered ore.

By similar means, capacity in 1943 is expected to rise to 70,351,410 tons. This includes merchant pig iron and ferroalloys. Every indication is that 15 new furnaces will go into blast during 1943. Bethlehem will have two new smelters, one at Bethlehem, Pa., and one at Lackawanna, N. Y. Carnegie-Illinois adds two at Braddock, Pa., and Columbia Steel will have an additional three at Geneva, Utah, and one more at Provo. Inland is slated to blow two in at Indiana Harbor and Pittsburgh Steel will put into operation its new plant at Monessen, Pa. In the Southwest, two new furnaces will start making pig iron in 1943. Lone Star Steel Co. at Dangerfield, Tex., will blow in its stack and Sheffield Steel Corp. will run one at Houston. Republic Steel Corp. is scheduled to have its new furnaces at Chicago and Cleveland completed by next year. These new furnaces will augment yearly capacity by 4,378,000 tons. The remainder, 218,000 tons, is expected from the use of sintered ore.

Custom-built GEARS...
For more than forty years we have specialized in making cut gears of practically every type.
Our manufacturing facilities enable us to make spur gears from 1" to 30 feet in diameter, bevel gears up to 13 feet in diameter and worm gears of any practical size. We also specialize in cutting racks with medium to heavy pitches.
We also manufacture related products including gear reducer units, bridge operating machinery, machinery for gates and locks and other special machinery of which gears constitute an important part.
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Let us Help you Solve Your Gear Problems
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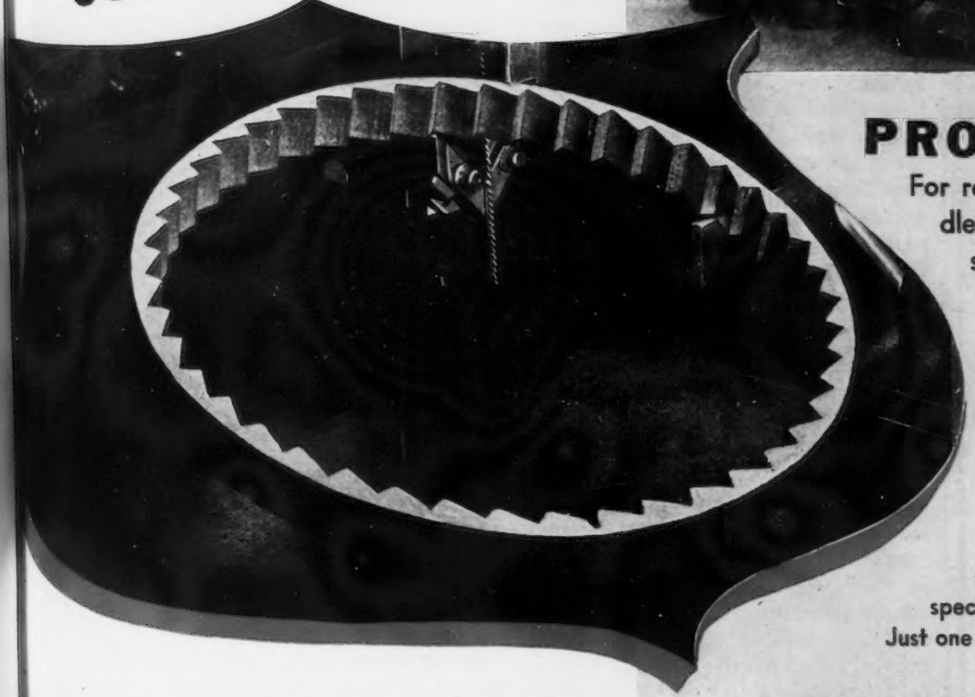
IT BEATS ALL WHAT DoAll WILL DO!



PRODUCTION WORK

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URGENT SPECIAL PARTS

Make them the same day on the DoAll. At left is an Internal Ratchet cut from 1½" steel in one hour. Formerly it was made on a special fixture in a shaper and required 4 hours. Just one instance in thousands.

SEE DoALL WORK

Actual performance records of the DoAll may sound unreal to some people, but after you see how speedily the hard-toothed blading eats its way through any metal or alloy, you'll want one or more DoAlls for your own use.

Let us send a factory trained man with a DoAll to show you what it can actually do and save in the way of man hours, man power and metal—how it takes the place of shaper, miller and lathe—how it relieves other machines of overload work.

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THE RIGHT SIZE FOR EVERY DEPARTMENT

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Under $5000 | Under $2500 | Under $2000 | Under $1500 | Under $1000

MASTER GAGE BLOCKS

81-piece sets made in following accuracies:
LABORATORY Set, 2 millionths of an inch
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Write for data on good deliveries

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Finest grinder made for those who require high precision accuracy as to size, flatness and parallelism. Adaptable to wet or dry grinding.

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Come in easy-to-use Strip Out Boxes. Each box contains 100 ft. of blading that has passed triple inspection.

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Nearly 50 Years of Service to the Steel Industry

In the early days of our steel expansion, before the United States Steel Corporation had been formed, the Charles Dreifus Company had its beginning.

The Charles Dreifus Company, as a broker in iron and steel scrap, still has as its customers some who were its customers nearly 50 years ago (or their successors). We are proud of this record.

Steel companies and scrap producers, as well as such Government agencies as the War Production Board, the Office of Price Administration and the Army and Navy, recognize the important role of the scrap broker in keeping the iron and steel industry operating at a rate that will bring a speedy and victorious conclusion of the war.

We solicit further opportunities to be of service in the movement of iron and steel scrap from industrial plants, railroads and scrap yards to steel plants and foundries.

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Worcester 6-2535

Aircraft Development in 1941

(CONTINUED FROM PAGE 109)

Navy seems to be one of the developments indicated for the near future.

Which brings us to another development of 1942. Until then the tactics of the use of aircraft carriers seems to have been misunderstood by every nation. H.M.S. *Illustrious* seems to have been as nearly an unsinkable ship as possible, but she was nearly sunk in the Mediterranean during the battle for Crete. When in October, 1942, a great convoy was taken to Malta by Admiral Lister, R. N., who had been Chief of the Air Department in the British Admiralty, he took three aircraft carriers with him so that fighters from one could protect another carrier while its fighters in turn were taking off to protect the ships of the convoy. Using a single aircraft carrier by itself is like trying to operate an Air Force from a single airdrome which is within bombing range of the enemy's Air Force.

Without much imagination one can see that in the future sea war will largely consist of fleets of aircraft carriers in which one squadron will carry the necessary bombers or torpedo craft while that squadron in turn will be protected against enemy bombing attacks or against torpedoes by fighters and bombers from yet another squadron of carriers.

Already in the Pacific U. S. and Japanese carriers have sunk one another and their attendant cruisers or destroyers by aircraft attack when the opposing fleets have never even sighted one another. That in itself is one of the important developments of 1942. When General Doolittle and his little squadron of bombers flew across Tokio and Yokohama and dropped a few token bombs they started something which, if properly developed, will mean the end of Japanese domination of the Pacific.

I find that the only mention I have made of German four-motor giant aircraft is to the Focke-Wulf Kurier, which has been used as an ocean scout for convoys. The Germans have other big four-motor craft, for example, the Ju.290, a development of the earlier four-motor Ju.90, which was known before the war as the *Grosser Dessauer*. It has been seen in Libya and is apparently used as a troop carrier.

A rumor in a U. S. popular paper to the effect that all the great German aircraft firms are building colossal four-engine bombers and that 15,000 or 20,000 of them are in stock but cannot be used for lack of gasoline may be rejected as an ingenious or disingenuous rumor, intended to make our flesh creep. Those who have the most knowledge of German manpower and workshop space know that such machines could never have been built while at the same time the German aircraft industry was turning out the masses of machines which have been used on all the various fronts.

Another German giant which must make even Mr. Kaiser sit up and think is a six-engined flying-boat built by Blohm and Voss, the great shipbuilding firm. Just what the Germans expect to do with it is not clear.

Another development of 1942 in Germany about which little is known is the Ju.252 which appears to be a development of the ever-popular Ju.52, the three-motor Junkers which looks as if it were made of corrugated iron, but is nevertheless one of the most efficient airplanes of its power yet built. The type has been used in thousands by the German Army, rather than the Luftwaffe, during 1941-42. Hundreds of them were thrown away in capturing Crete. It is used to tow trains of gliders, it is used for the dropping of parachute troops and it is used simply as a troop carrier with 20 or 25 men packed into a cabin which normally seats about 14.

People have often expressed wonder that at the time of the Battle of Britain in 1940 Hitler did not send his enormous bomber force to attack the Midland and North Country industrial centers of England. The truth is that so much man-hours and material had been spent in building these vast fleets of troop carriers that there were just not enough bombers in the Luftwaffe to attack the north. And perhaps I may be allowed to add that if such an attack had been

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made it would have been met just as powerfully as was the attack on the south coast of England. There is a popular illusion that at the end of the Battle of Britain we had practically no fighter force left.

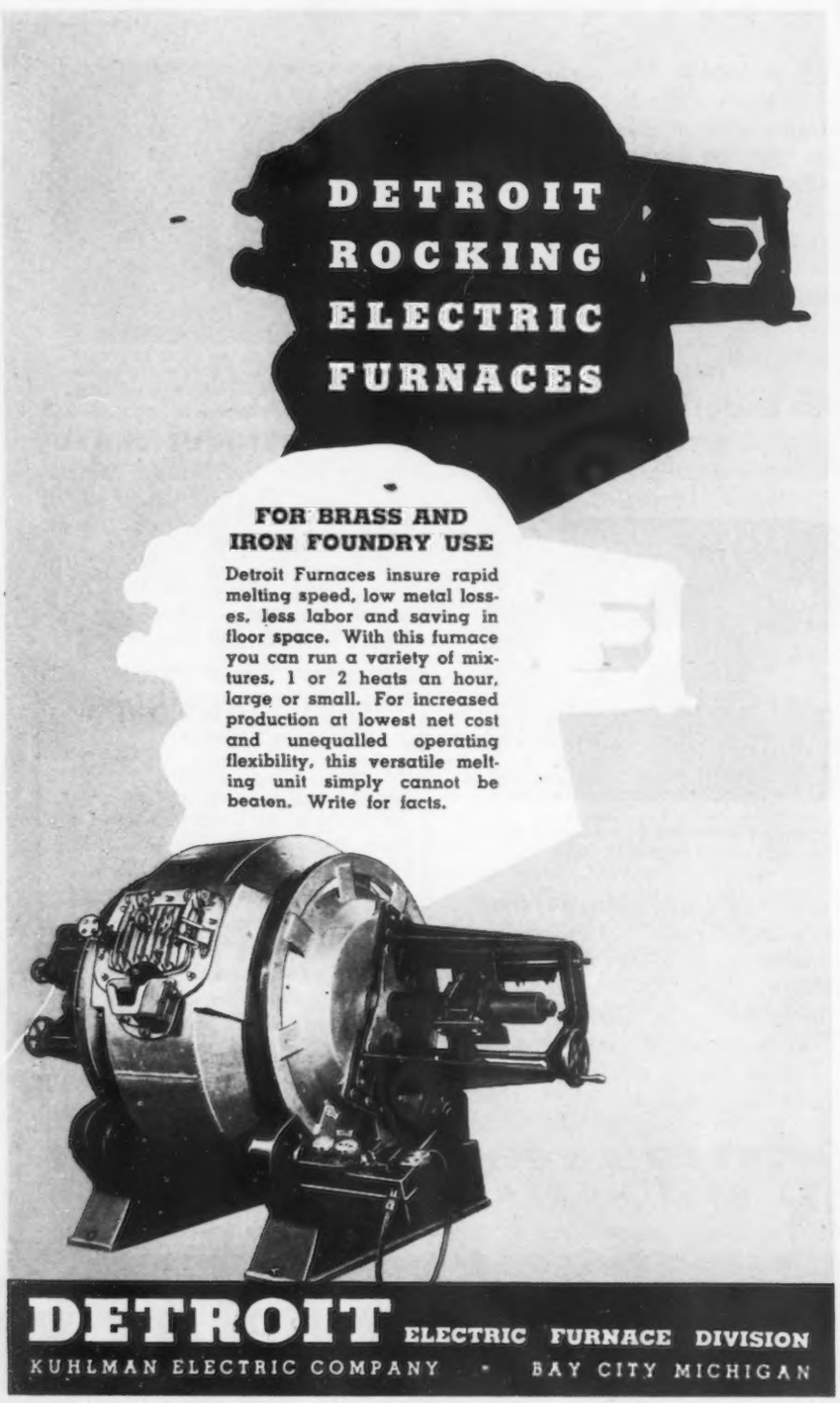
As a plain matter of history we had a whole string of fighter squadrons all the way from the Thames to the north of Scotland waiting for an attack from the east which never came. And those squadrons never went into action, much to their annoyance. The Battle of Britain was won by No. 11 group between London and Weymouth, with some help from No. 10 in the west and No. 12 group north of the Thames. No. 11 group was commanded by Air Chief Marshal Keith Park, who during this last critical phase in the Mediterranean commanded the defense of Malta.

During 1942 the training of parachute troops and of airborne troops to be carried in gliders has been going ahead hard in the United States and in Great Britain. No doubt we shall see parachute troops used quite considerably in the next phases of the war whether that may be an all-out attack on Italy or a serious invasion of France or the Lowlands or of Germany itself. Airborne troops are specially trained types and one cannot imagine any sensible general wasting them by throwing them away in quantities in an unprofitable venture.

In their attack on Greece the Germans used airborne troops quite cleverly in places. But in their attack on Crete men and machines were thrown away, and when captured Crete was really worth very little. During the fighting in Africa in October-November, 1942, something was heard of airborne reinforcements to Rommel in Libya and in Egypt from Crete. But, such was the superiority of the Allied Air Forces in Egypt during that time that there would have been very little chance of any considerable number of airborne troops crossing the Mediterranean without being spotted and destroyed by the Allied Air Forces.

And here by way of conclusion I should like to pay a tribute to that eminent citizen of the U. S. A., Mr. Leslie Irvin (without a g), designer and first tester of the Irving (with a g) Airchute, to whom so many pilots and air crews of the Allied Nations owe their lives. There is a popular idea that the Russians invented the idea of parachute troops. Actually the suggestion was first made in a story by Lt.-Col. L. V. S. Blacker, of the Corps of Guides, Indian Army, in 1921. In 1926 Mr. Irvin went to Russia and showed the Russians how to use parachutes. And for several succeeding years the Irving Airchute Co. supplied many thousands of parachutes to Russia. The increasing number of parachute troops is one of the extraordinary developments of 1942.

Undoubtedly the colossal output of the Allied aircraft industries in 1942-43 will be one of the major factors in winning the war. And the increasing use of air transport in the future coupled with the organization of an efficient and trustworthy International Air Police Force will be a major factor in keeping the peace after the war.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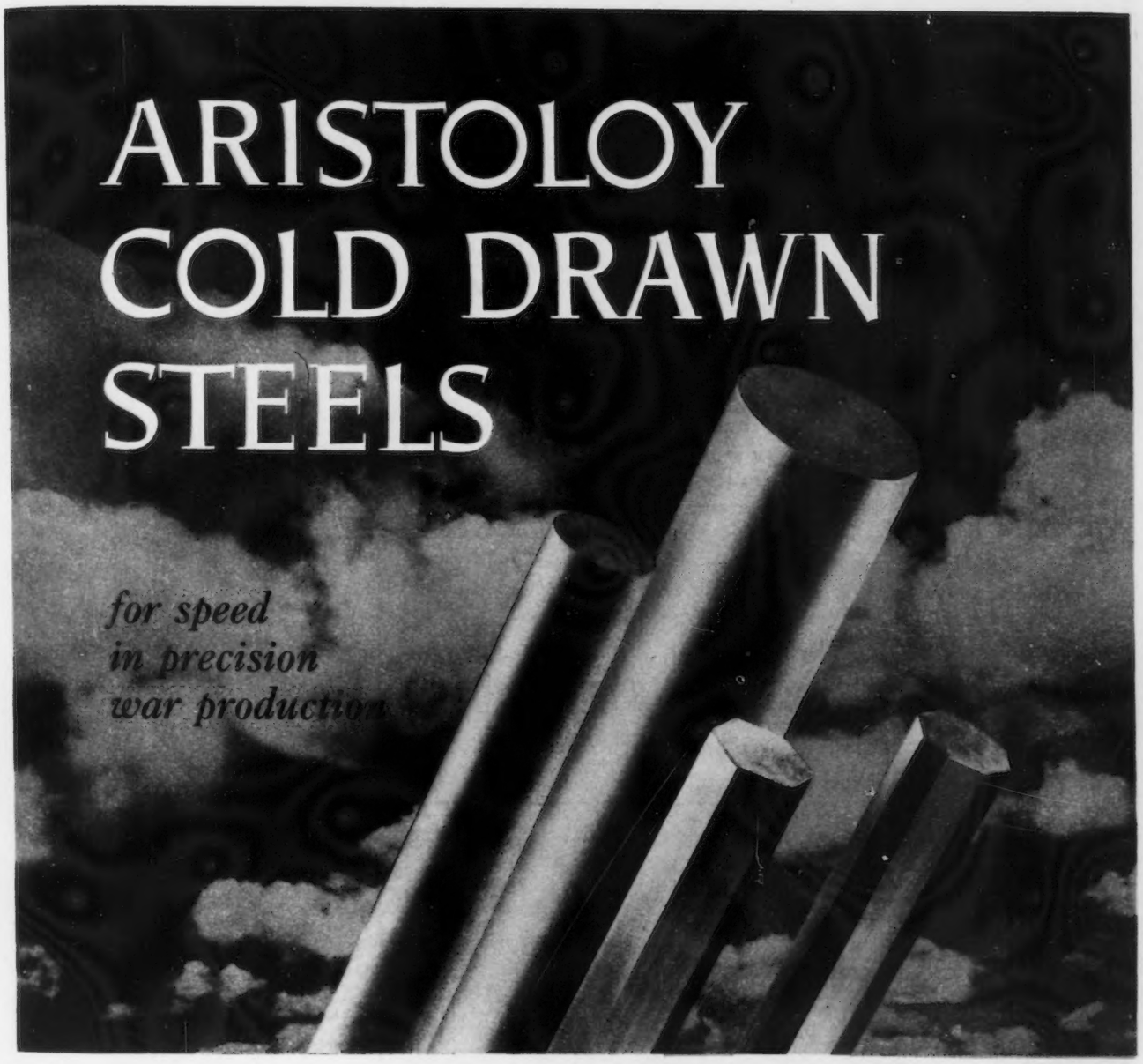

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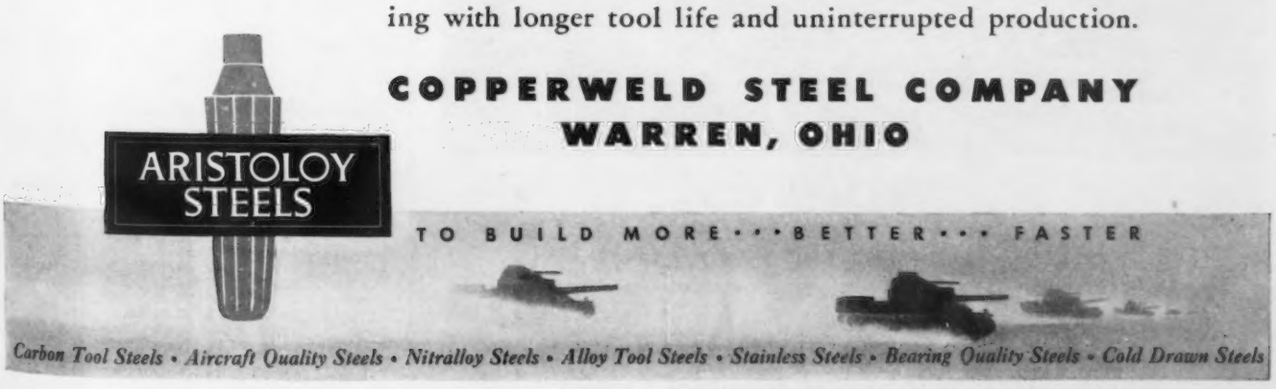

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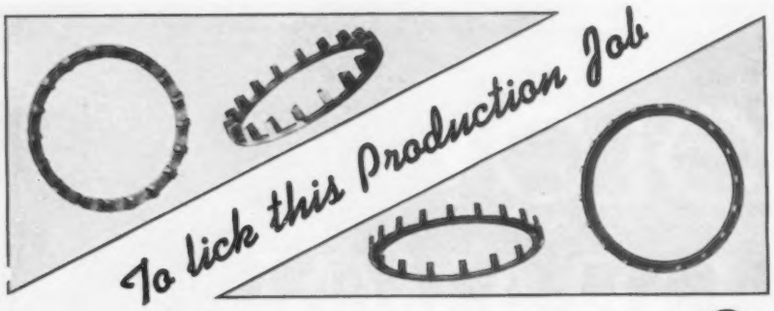

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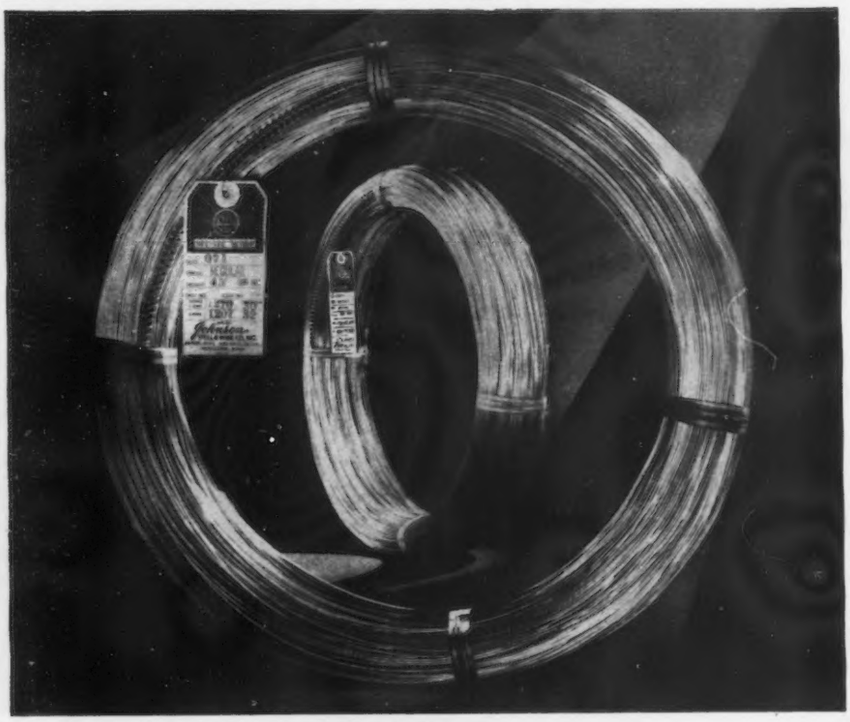

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STATISTICAL

Composite Pig Iron Price

Average of THE IRON AGE quotations on basic pig iron at Valley furnace and foundry iron at Chicago, Birmingham, Buffalo, Valley and Philadelphia, quoted in gross tons.

	1925	1926	1927	1928	1929	1930
January	$22.44	$21.79	$19.44	$17.63	$18.43	$18.19
February	22.50	21.77	19.07	17.73	18.38	18.02
March	21.99	21.65	19.03	17.73	18.36	17.75
April	20.95	20.96	19.21	17.67	18.52	17.73
May	19.85	20.69	19.09	17.45	18.70	17.60
June	19.22	20.00	18.92	17.23	18.65	17.48
July	18.96	19.51	18.56	17.10	18.48	17.16
August	19.01	19.46	18.17	17.11	18.39	16.90
September	19.39	19.46	18.03	17.54	18.27	16.70
October	19.92	19.69	17.96	17.94	18.33	16.31
November	21.16	20.13	17.59	18.46	18.36	16.21
December	21.54	19.94	17.55	18.51	18.24	15.95
Average	20.58	20.42	18.55	17.68	18.43	17.17

	1931	1932	1933	1934	1935	1936
January	$15.90	$14.68	$13.56	$16.90	$17.90	$18.84
February	15.80	14.51	13.56	16.90	17.90	18.84
March	15.71	14.45	13.56	16.90	17.90	18.84
April	15.79	14.35	13.76	17.07	17.90	18.84
May	15.76	14.12	14.48	17.90	17.85	18.84
June	15.62	14.01	15.01	17.90	17.84	18.84
July	15.56	13.76	15.50	17.90	17.84	18.84
August	15.51	13.69	16.09	17.90	17.84	18.73
September	15.44	13.64	16.71	17.90	17.84	18.73
October	15.21	13.63	16.61	17.90	17.87	18.73
November	14.97	13.59	16.61	17.90	18.84	18.98
December	14.86	13.56	16.90	17.90	18.84	19.73
Average	15.51	14.00	15.20	17.58	18.03	18.90

	1937	1938	1939	1940	1941	1942
January	$20.25	$23.25	$20.61	$22.61	$23.45	$23.61
February	20.50	23.25	20.61	22.61	23.45	23.61
March	22.85	23.25	20.61	22.61	23.53	23.61
April	23.25	23.25	20.61	22.61	23.61	23.61
May	23.25	23.25	20.61	22.61	23.61	23.61
June	23.25	22.98	20.61	22.61	23.61	23.61
July	23.25	19.61	20.61	22.61	23.61	23.61
August	23.25	19.61	20.61	22.61	23.61	23.61
September	23.25	19.82	21.61	22.61	23.61	23.61
October	23.25	20.57	22.61	22.61	23.61	23.61
November	23.25	20.61	22.61	22.61	23.61	23.61
December	23.25	20.61	22.61	22.95	23.61	23.61
Average	22.74	21.67	21.19	22.64	23.58	23.61

—The Iron Age—

Lake Superior Charcoal Pig Iron, at Chicago, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$27.04	$23.17	$23.17	$23.54	$24.04	$25.25
February	27.04	23.17	23.17	23.54	24.04	25.25
March	27.04	23.17	23.17	23.54	24.04	25.25
April	27.04	23.17	23.17	24.79	24.13	25.25
May	27.04	23.17	23.17	24.04	24.25	25.25
June	27.04	23.17	23.17	24.04	24.25	25.25
July	27.04	23.17	23.17	24.04	24.25	25.25
August	27.04	23.17	23.17	24.04	24.25	25.25
September	27.04	23.17	23.67	24.04	24.25	25.25
October	27.04	23.17	23.54	24.04	24.85	25.25
November	27.04	23.17	23.54	24.04	25.25	25.50
December	27.04	23.17	23.54	24.04	25.25	26.25
Average	27.04	23.17	23.30	23.98	24.35	25.35

	1937	1938	1939	1940	1941	1942
January	$26.54	$30.24	$28.34	$30.34	$30.34	$31.34
February	26.79	30.24	28.34	30.34	30.34	31.34
March	29.44	30.24	28.34	30.34	30.34	31.34
April	30.04	30.32	28.34	30.34	30.34	31.34
May	30.04	30.34	28.34	30.34	31.09	31.34
June	30.04	30.34	28.34	30.34	31.34	31.34
July	30.04	28.34	28.34	30.34	31.34	31.34
August	30.04	28.34	28.34	30.34	31.34	31.34
September	30.04	28.34	29.34	30.34	31.34	31.34
October	30.04	28.34	30.34	30.34	31.34	31.34
November	30.16	28.34	30.34	30.34	31.34	31.34
December	30.24	28.34	30.34	30.34	31.34	31.34
Average	29.45	29.31	28.92	30.34	30.99	31.34

—The Iron Age—

Basic Pig Iron at Mahoning or Shenango Valley Furnace, Gross Ton

	1937	1938	1939	1940	1941	1942
January	$20.50	$23.50	$20.50	$22.50	$23.50	$23.50
February	20.75	23.50	20.50	22.50	23.50	23.50
March	23.10	23.50	20.50	22.50	23.50	23.50
April	23.50	23.50	20.50	22.50	23.50	23.50
May	23.50	23.50	20.50	22.50	23.50	23.50
June	23.50	22.70	20.50	22.50	23.50	23.50
July	23.50	19.50	20.50	22.50	23.50	23.50
August	23.50	19.50	20.50	22.50	23.50	23.50
September	23.50	19.75	21.50	22.50	23.50	23.50
October	23.50	20.50	22.50	22.50	23.50	23.50
November	23.50	20.50	22.50	22.50	23.50	23.50
December	23.50	20.50	22.50	22.90	23.50	23.50
Average	22.99	21.70	21.09	22.53	23.50	23.50

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No. 2 Foundry Pig Iron at Buffalo Furnace, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$18.00	$16.00	$16.00	$17.50	$18.50	$19.50
February	18.39	16.00	16.00	17.50	18.50	19.50
March	18.50	16.00	16.00	17.50	18.50	19.50
April	18.50	16.00	16.00	17.50	18.50	19.50
May	18.50	16.00	16.00	18.50	18.50	19.50
June	18.75	16.00	16.00	18.50	18.50	19.50
July	19.50	16.00	16.50	18.50	18.50	19.50
August	19.50	16.00	17.10	18.50	18.50	19.50
September	19.50	16.00	17.50	18.50	18.50	19.50
October	19.50	16.00	17.50	18.50	18.50	19.50
November	19.50	16.00	17.50	18.50	19.50	19.75
December	19.50	16.00	17.50	18.50	19.50	20.50
Average	18.97	16.00	16.63	18.17	18.67	19.60

	1937	1938	1939	1940	1941	1942
January	$21.00	$24.00	$21.00	$23.00	$24.00	$24.00
February	21.25	24.00	21.00	23.00	24.00	24.00
March	23.60	24.00	21.00	23.00	24.00	24.00
April	24.00	24.00	21.00	23.00	24.00	24.00
May	24.00	24.00	21.00	23.00	24.00	24.00
June	24.00	23.20	21.00	23.00	24.00	24.00
July	24.00	20.00	21.00	23.00	24.00	24.00
August	24.00	20.00	21.00	23.00	24.00	24.00
September	24.00	20.13	22.00	23.00	24.00	24.00
October	24.00	20.88	23.00	23.00	24.00	24.00
November	24.00	21.00	23.00	23.00	24.00	24.00
December	24.00	21.00	23.00	23.40	24.00	24.00
Average	23.49	22.18	21.59	23.03	24.00	24.00

No. 2 Foundry Pig Iron at Mahoning or Shenango Valley Furnace, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$17.50	$15.50	$14.50	$17.50	$18.50	$19.50
February	17.50	15.12	14.50	17.50	18.50	19.50
March	17.75	15.00	14.50	17.50	18.50	19.50
April	18.00	15.00	14.50	17.75	18.50	19.50
May	18.50	14.70	14.70	18.50	18.50	19.50
June	18.50	14.50	15.50	18.50	18.50	19.50
July	18.50	14.50	16.00	18.50	18.50	19.50
August	18.50	14.50	16.70	18.50	18.50	19.50
September	18.50	14.50	17.50	18.50	18.50	19.50
October	18.50	14.50	17.50	18.50	18.50	19.50
November	18.50	14.50	17.50	18.50	19.50	19.75
December	18.50	14.50	17.50	18.50	19.50	20.50
Average	18.23	14.73	15.91	18.19	18.67	19.60

	1937	1938	1939	1940	1941	1942
January	$21.00	$24.00	$21.00	$23.00	$24.00	$24.00
February	21.25	24.00	21.00	23.00	24.00	24.00
March	23.60	24.00	21.00	23.00	24.00	24.00
April	24.00	24.00	21.00	23.00	24.00	24.00
May	24.00	24.00	21.00	23.00	24.00	24.00
June	24.00	23.20	21.00	23.00	24.00	24.00
July	24.00	20.00	21.00	23.00	24.00	24.00
August	24.00	20.00	21.00	23.00	24.00	24.00
September	24.00	20.25	22.00	23.00	24.00	24.00
October	24.00	21.00	23.00	23.00	24.00	24.00
November	24.00	21.00	23.00	23.00	24.00	24.00
December	24.00	21.00	23.00	23.40	24.00	24.00
Average	23.49	22.20	21.59	23.03	24.00	24.00

The Iron Age

No. 2 Foundry Pig Iron at Chicago Furnace, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$20.00	$16.50	$15.50	$17.50	$18.50	$19.50
February	20.00	16.50	15.50	17.50	18.50	19.50
March	20.00	16.50	15.50	17.50	18.50	19.50
April	20.00	16.00	15.50	17.75	18.50	19.50
May	20.00	16.00	15.80	18.50	18.50	19.50
June	20.00	16.00	16.00	18.50	18.50	19.50
July	20.00	15.50	16.78	18.50	18.50	19.50
August	20.00	15.50	17.10	18.50	18.50	19.50
September	20.00	15.50	17.50	18.50	18.50	19.50
October	20.00	15.50	17.50	18.50	18.70	19.50
November	20.00	15.50	17.50	18.50	19.50	19.75
December	20.00	15.50	17.50	18.50	19.50	20.50
Average	20.00	15.87	16.47	18.19	18.68	19.60

	1937	1938	1939	1940	1941	1942
January	$21.00	$24.00	$21.00	$23.00	$24.00	$24.00
February	21.25	24.00	21.00	23.00	24.00	24.00
March	23.60	24.00	21.00	23.00	24.00	24.00
April	24.00	24.00	21.00	23.00	24.00	24.00
May	24.00	24.00	21.00	23.00	24.00	24.00
June	24.00	23.20	21.00	23.00	24.00	24.00
July	24.00	20.00	21.00	23.00	24.00	24.00
August	24.00	20.00	21.00	23.00	24.00	24.00
September	24.00	20.25	22.00	23.00	24.00	24.00
October	24.00	21.00	23.00	23.00	24.00	24.00
November	24.00	21.00	23.00	23.00	24.00	24.00
December	24.00	21.00	23.00	23.40	24.00	24.00
Average	23.49	22.20	21.59	23.03	24.00	24.00

The Iron Age

No. 2 Foundry Pig Iron at Granite City, Ill., Furnace, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$20.75	$18.33	$18.33	$17.50	$18.50	$19.50
February	20.75	18.33	18.33	17.50	18.50	19.50
March	20.75	18.33	18.33	17.50	18.50	19.50
April	20.75	18.33	17.34	17.75	18.50	19.50
May	20.75	18.33	16.55	18.50	18.50	19.50
June	20.75	18.33	16.85	18.50	18.50	19.50
July	20.75	18.33	17.35	18.50	18.50	19.50
August	20.69	18.33	17.85	18.50	18.50	19.50
September	20.50	18.33	17.50	18.50	18.50	19.50
October	20.50	18.33	17.50	18.50	18.70	19.50
November	20.50	18.33	17.50	18.50	19.50	19.75
December	20.50	18.33	17.50	18.50	19.50	20.50
Average	20.66	18.33	17.58	18.19	18.68	19.60

	1937	1938	1939	1940	1941	1942
January	$21.00	$24.00	$21.00	$23.00	$24.00	$24.00
February	21.25	24.00	21.00	23.00	24.00	24.00
March	23.60	24.00	21.00	23.00	24.00	24.00
April	24.00	24.00	21.00	23.00	24.00	24.00
May	24.00	24.00	21.00	23.00	24.00	24.00
June	24.00	23.00	21.00	23.00	24.00	24.00
July	24.00	20.00	21.00	23.00	24.00	24.00
August	24.00	20.00	21.00	23.00	24.00	24.00
September	24.00	20.25	22.00	23.00	24.00	24.00
October	24.00	21.00	23.00	23.00	24.00	24.00
November	24.00	21.00	23.00	23.00	24.00	24.00
December	24.00	21.00	23.00	23.50	24.00	24.00
Average	23.49	22.20	21.59	23.04	24.00	24.00

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Yes, here is an exceptionally low tin base (less than 1½% tin) babbitt metal that was developed more than 20 years ago, and which has proven, in bearing applications having rotary motion, to be comparable with (and in some cases superior to) many babbitt metals of the high tin base type. It is tough, strong, resistant and hard, and represents the ideal bearing metal that will give satisfactory performance, and at the same time help conserve precious tin. We are always ready to answer casual questions or comprehensive inquiries concerning bearing metals, so don't hesitate to consult us; there is no obligation, of course.

A. W. Cadman MFG. CO., PITTSBURGH, PA.

CHICAGO: Manhattan Bldg. PHILADELPHIA: 18 W. Chelten Av. NEW YORK: 270 Broadway

Malleable Pig Iron at Mahoning or Shenango Valley Furnace, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$18.00	$16.00	$14.50	$17.50	$18.50	$19.50
February	18.00	15.62	14.50	17.50	18.50	19.50
March	18.25	15.50	14.50	17.50	18.50	19.50
April	18.50	15.50	14.50	17.75	18.50	19.50
May	19.00	15.20	14.70	18.50	18.50	19.50
June	19.00	15.00	15.50	18.50	18.50	19.50
July	19.00	14.50	16.00	18.50	18.50	19.50
August	19.00	14.50	16.70	18.50	18.50	19.50
September	19.00	14.50	17.50	18.50	18.50	19.50
October	19.00	14.50	17.50	18.50	18.50	19.50
November	19.00	14.50	17.50	18.50	19.50	19.75
December	19.00	14.50	17.50	18.50	19.50	20.50
Average	18.73	14.98	15.91	18.19	18.67	19.60

	1937	1938	1939	1940	1941	1942
January	$21.00	$24.00	$21.00	$23.00	$24.00	$24.00
February	21.25	24.00	21.00	23.00	24.00	24.00
March	23.60	24.00	21.00	23.00	24.00	24.00
April	24.00	24.00	21.00	23.00	24.00	24.00
May	24.00	24.00	21.00	23.00	24.00	24.00
June	24.00	23.20	21.00	23.00	24.00	24.00
July	24.00	20.00	21.00	23.00	24.00	24.00
August	24.00	20.00	21.00	23.00	24.00	24.00
September	24.00	20.25	22.00	23.00	24.00	24.00
October	24.00	21.00	23.00	23.00	24.00	24.00
November	24.00	21.00	23.00	23.00	24.00	24.00
December	24.00	21.00	23.00	23.50	24.00	24.00
Average	23.49	22.20	21.59	23.04	24.00	24.00

—The Iron Age—

Lake Superior Iron Ores, Per Gross Ton, at Lake Erie Ports

	Bessemer Ores			
	Analysis Guarantee		Price	
	Iron Natural	Phosphorus Dry	Old Range	Mesaba
1914	55.00	0.045	$3.75	$3.50
1915	55.00	0.045	3.75	3.45
1916	55.00	0.045	4.45	4.20
1917	55.00	0.045	5.95	5.70
1918 to July 1	55.00	0.045	5.95	5.70
1918–July 1 to Sept. 30	55.00	0.045	6.40	6.15
1918–Oct. 1 to Close	55.00	0.045	6.65	6.40
1919	55.00	0.045	6.45	6.20
1920	55.00	0.045	7.45	7.20
1921	55.00	0.045	6.45	6.20
1922	55.00	0.045	5.95	5.70
1923	55.00	0.045	6.45	6.20
1924	55.00	0.045	4.65	5.40
1925 through 1928	51.50	0.045	4.55	4.40
1929 through 1936	51.50	0.045	4.80	4.65
1937 to April 15, 1940	51.50	0.045	5.25	5.10
1940–April 16 to Close	51.50	0.045	4.75	4.60
1941	51.50	0.045	4.75	4.60
1942	51.50	0.045	4.75	4.60

	Non-Bessemer Ores			
	Analysis Guarantee	Price		
	Iron Natural	Old Range	Mesaba	High Phosphorus
1914	51.50	$3.00	$2.85	....
1915	51.50	3.00	2.80	....
1916	51.50	3.70	3.55	....
1917	51.50	5.20	5.05	....
1918 to July 1	51.50	5.20	5.05	....
1918–July 1 to Sept. 30	51.50	5.65	5.50	....
1918–Oct. 1 to Close	51.50	5.90	5.75	....
1919	51.50	5.70	5.55	$5.35
1920	51.50	6.70	6.55	6.35
1921	51.50	5.70	5.55	5.35
1922	51.50	5.20	5.05	4.85
1923	51.50	5.70	5.55	5.35
1924	51.50	4.90	4.75	4.55
1925 through 1928	51.50	4.40	4.25	4.15
1929 through 1936	51.50	4.65	4.50	4.40
1937 to April 15, 1940	51.50	5.10	4.95	4.85
1940–April 16 to Close	51.50	4.60	4.45	4.35
1941	51.50	4.60	4.45	4.35
1942	51.50	4.60	4.45	4.35

—The Iron Age—

Lake Superior Iron Ore Shipments Water Movement, Gross Tons

1929	1932	1933	1934
65,204,600	3,567,985	21,623,898	22,249,600
1935	**1936**	**1937**	**1938**
28,362,368	44,822,023	62,598,836	19,263,011
1939	**1940**	**1941**	**1942**
45,072,725	63,712,982	80,116,360	92,028,325

Southern No. 2 Foundry Pig Iron at Birmingham, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$16.50	$11.50	$11.00	$13.50	$14.50	$15.50
February	16.50	11.00	11.00	13.50	14.50	15.50
March	16.00	11.00	11.00	13.50	14.50	15.50
April	15.40	11.00	11.25	13.50	14.50	15.50
May	15.00	11.00	12.00	14.30	14.50	15.50
June	15.00	11.00	12.00	14.50	14.50	15.50
July	14.63	11.00	12.50	14.50	14.50	15.50
August	14.50	11.00	13.10	14.50	14.50	*15.88
September	14.50	11.00	13.50	14.50	14.50	15.88
October	14.50	11.00	13.50	14.50	14.50	15.88
November	14.50	11.00	13.50	14.50	14.75	16.13
December	14.50	11.00	13.50	14.50	15.50	16.88
Average	15.13	11.04	12.32	14.15	14.60	15.76

	1937	1938	1939	1940	1941	1942
January	$17.38	$20.38	$17.38	$19.38	$19.38	$20.38
February	17.63	20.38	17.38	19.38	19.38	20.38
March	19.98	20.38	17.38	19.38	19.89	20.38
April	20.38	20.38	17.38	19.38	20.38	20.38
May	20.38	20.38	17.38	19.38	20.38	20.38
June	20.38	19.58	17.38	19.38	20.38	20.38
July	20.38	16.38	17.38	19.38	20.38	20.38
August	20.38	16.38	17.38	19.38	20.38	20.38
September	20.38	16.63	18.38	19.38	20.38	20.38
October	20.38	17.38	19.38	19.38	20.38	20.38
November	20.38	17.38	19.38	19.38	20.38	20.38
December	20.38	17.38	19.38	19.38	20.38	20.38
Average	19.87	18.58	17.96	19.38	20.17	20.38

* Beginning August, 1936, 38c. a ton deducted for 0.70 phosphorus and over.

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"...and we're depending on you!"

We at home are relying on the courage of our fighting men to protect the things we hold dear. But courage alone cannot win battles. Our men are counting on us for a continuous supply of guns, shells, tanks, ships, planes, bombs, food.

Let's not let them down. Let's maintain peak production by avoiding waste, working hard and buying War Bonds!

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FASTER MILLING with the
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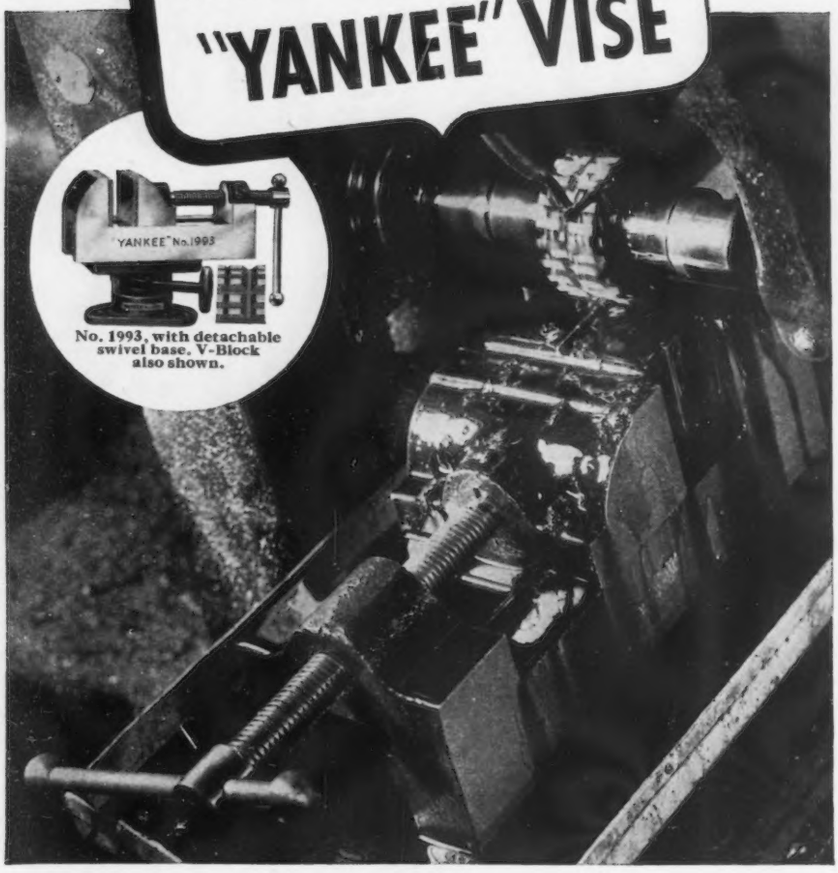

No. 1993, with detachable swivel base. V-Block also shown.

Cut out waste motions—they are costly and time-consuming! The "Yankee" Vise is designed to speed production. Once work is squared on face plate or machine bed it *stays* squared because the sides, front end and base of the "Yankee" Vise are accurately machined. If work must be moved from bench to drill press or milling machine, it can be done quickly and easily without realignment. The same vise can be used for round stock, simply by inserting a hardened steel V-block that's furnished as standard equipment. All these "Yankee" features save time and production costs.

Order from your supply house . . . or write North Bros. Mfg. Co., Dept. IA1, Phila., Pa., U. S. A.

"Yankee" Vises are made in four jaw widths and two styles. No. 991 —1½"; No. 992—2"; No. 993—2¾"; No. 994 —4". These same sizes with the detachable swivel base feature are Nos. 1991, 1992, 1993, 1994.

"YANKEE" TOOLS
make good mechanics better
NORTH BROS. MFG. CO., Phila., U.S.A.

STATISTICAL

Scrap Steel Composite Price

Average of THE IRON AGE *quotations on No. 1 heavy melting scrap at Pittsburgh, Chicago and Philadelphia—Gross ton.*

	1929	1932	1933	1934	1935	1936
January	$17.02	$8.41	$6.77	$11.73	$12.29	$13.47
February	16.96	8.27	6.83	12.25	11.98	14.12
March	16.71	8.23	6.96	12.82	11.06	14.76
April	17.18	8.12	7.73	12.54	10.46	14.59
May	16.54	7.48	9.70	11.57	10.70	13.39
June	16.39	6.89	9.97	10.67	10.74	12.81
July	16.60	6.46	11.27	10.53	10.96	13.29
August	16.86	6.93	12.08	10.15	12.25	15.04
September	16.60	7.69	11.35	9.63	12.71	16.45
October	15.78	7.62	10.56	9.54	12.67	16.63
November	14.83	7.45	9.94	10.04	12.90	16.31
December	14.15	6.92	10.50	11.43	13.33	17.10
Average	16.30	7.54	9.47	11.07	11.85	14.83

	1937	1938	1939	1940	1941	1942
January	$18.33	$14.00	$14.94	$17.58	$20.88	$19.17
February	19.27	13.86	15.01	16.88	20.08	19.17
March	21.25	13.46	15.20	16.56	20.29	19.17
April	21.02	12.40	14.77	16.14	19.22	19.17
May	18.54	11.54	14.17	17.60	19.17	19.17
June	17.28	11.32	14.71	19.31	19.17	19.17
July	18.79	13.29	14.92	18.47	19.17	19.17
August	20.43	14.51	15.43	18.72	19.17	19.17
September	18.73	14.34	18.32	19.91	19.17	19.17
October	15.89	14.21	21.48	20.63	19.17	19.17
November	13.34	14.74	19.66	20.83	19.17	19.17
December	13.46	14.88	18.05	21.42	19.17	19.17
Average	18.03	13.54	16.39	18.67	19.49	19.17

—The Iron Age—

No. 1 Heavy Melting Steel Scrap at Pittsburgh, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$19.31	$10.22	$8.30	$13.00	$13.35	$14.44
February	18.63	10.25	8.50	14.00	13.06	14.96
March	18.44	10.25	8.88	14.44	12.19	15.75
April	18.60	10.12	10.00	14.19	11.55	15.75
May	17.88	9.60	11.75	12.80	11.62	14.50
June	18.25	8.75	11.75	11.75	11.75	13.57
July	18.55	8.25	12.72	11.75	11.95	14.19
August	19.00	8.60	13.85	11.31	12.94	15.94
September	18.31	9.54	12.94	10.75	13.25	17.80
October	17.30	9.62	12.15	10.35	13.40	17.87
November	16.39	9.15	11.50	10.94	13.56	17.31
December	15.45	8.75	12.13	13.01	14.05	18.31
Average	18.01	9.42	11.21	12.36	12.72	15.87

	1937	1938	1939	1940	1941	1942
January	$19.50	$14.25	$15.72	$18.35	$22.13	$20.00
February	19.81	14.13	15.72	17.50	21.00	20.00
March	23.15	13.67	15.97	16.88	21.00	20.00
April	22.25	12.44	15.31	16.55	20.20	20.00
May	19.38	11.50	14.48	18.37	20.00	20.00
June	18.45	11.30	15.12	20.06	20.00	20.00
July	19.75	14.25	15.56	19.10	20.00	20.00
August	21.85	15.45	16.15	18.56	20.00	20.00
September	19.62	15.25	19.88	20.00	20.00	20.00
October	16.62	15.00	23.05	21.45	20.00	20.00
November	13.75	15.28	20.56	21.69	20.00	20.00
December	13.75	15.75	18.58	22.28	20.00	20.00
Average	18.86	14.02	17.17	19.23	20.36	20.00

—The Iron Age—

No. 1 Heavy Melting Steel Scrap at Chicago, Gross Ton

	1937	1938	1939	1940	1941	1942
January	$17.81	$13.00	$13.87	$16.38	$20.00	$18.75
February	19.25	12.69	13.94	15.75	19.25	18.75
March	20.60	12.15	14.25	15.69	19.88	18.75
April	20.56	11.37	13.37	15.33	18.95	18.75
May	17.12	11.00	12.75	17.00	18.75	18.75
June	15.70	10.45	13.45	18.19	18.75	18.75
July	17.62	12.00	13.50	17.35	18.75	18.75
August	19.70	13.75	13.87	18.03	18.75	18.75
September	17.56	13.50	16.22	19.22	18.75	18.75
October	14.69	12.88	19.16	19.75	18.75	18.75
November	12.50	14.20	17.85	20.06	18.75	18.75
December	12.38	13.75	16.67	20.60	18.75	18.75
Average	17.12	12.56	14.91	17.73	19.01	18.75

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CHECK THESE ADVANTAGES OF BLANCHARD GRINDING

- Production
- ★ Adaptability
- ★ Fixture Saving
- Operation Saving
- Material Saving
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- ★ Flatness
- Close Limits

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THE surfaces on these bearing caps were formerly milled in 34 to 40 minutes each — now they are Blanchard ground at the rate of 7 pieces per hour. The Blanchard No. 18 not only increases production, but decreases setting-up time and eliminates expensive fixtures.

The caps are laid on two parallel bars on the chuck. Smaller steel blocks are laid on top of them and against the caps. Two hollow steel rings against these blocks serve to hold the work sideways. A steel block is placed at each end and the magnetism is turned on.

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No. 1 Heavy Melting Steel Scrap, at Philadelphia, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$16.39	$7.00	$6.75	$11.70	$11.40	$12.62
February	16.39	7.00	6.75	11.75	11.62	13.25
March	16.13	7.00	6.75	11.88	10.50	13.75
April	17.00	7.50	7.19	11.69	10.00	13.69
May	16.39	6.00	8.90	10.95	10.44	12.81
June	16.00	6.00	9.25	10.50	10.50	12.00
July	16.50	6.00	10.68	10.30	10.55	12.31
August	16.50	6.30	11.95	9.94	11.44	14.00
September	16.39	7.25	11.25	9.63	12.38	15.40
October	15.70	7.25	10.20	9.53	12.10	15.75
November	15.00	7.25	9.75	9.94	12.13	15.12
December	14.50	6.75	10.44	10.75	12.50	15.50
Average	16.07	6.77	9.16	10.71	11.30	13.85

	1937	1938	1939	1940	1941	1942
January	$17.37	$14.75	$15.25	$18.00	$20.50	$18.75
February	18.50	14.75	15.25	17.38	20.00	18.75
March	19.60	14.55	15.38	17.12	20.00	18.75
April	20.00	13.37	15.62	16.75	19.00	18.75
May	18.62	12.13	15.25	17.56	18.75	18.75
June	17.20	12.20	15.41	19.69	18.75	18.75
July	19.00	13.63	15.62	18.95	18.75	18.75
August	19.75	14.35	16.25	19.56	18.75	18.75
September	19.00	14.25	18.87	20.50	18.75	18.75
October	16.38	14.75	22.35	20.70	18.75	18.75
November	13.75	14.75	20.75	20.75	18.75	18.75
December	14.25	15.12	18.92	20.85	18.75	18.75
Average	17.78	14.05	17.08	18.98	19.13	18.75

No. 1 Machinery Cast Scrap, at Chicago, Net Ton*

	1929	1932	1933	1934	1935	1936
January	$15.81	$7.75	$6.25	$9.50	$10.60	$12.00
February	16.25	7.50	6.25	9.50	10.00	12.75
March	16.00	7.20	6.25	9.50	9.38	13.10
April	16.00	7.00	7.06	9.50	9.00	12.50
May	15.39	6.50	8.45	8.90	9.00	12.00
June	14.75	6.13	8.75	7.50	9.00	12.00
July	14.50	6.00	10.63	8.05	9.30	12.12
August	14.50	6.10	10.50	8.00	10.87	13.37
September	14.50	6.25	10.00	8.00	11.19	13.60
October	14.50	6.25	9.88	8.00	11.25	14.00
November	13.63	6.25	8.60	8.25	11.50	14.00
December	13.50	6.25	8.75	9.65	11.80	14.75
Average	15.11	6.60	8.45	8.69	10.24	13.02

	1937	1938	1939	1940	1941	1942
January	$15.87	$12.50	$12.56	$14.00	$18.88	$20.00
February	16.25	12.19	12.75	13.75	19.25	20.00
March	17.40	11.65	12.75	13.56	20.75	20.00
April	17.12	10.88	12.12	14.81	*22.33	20.00
May	15.25	10.75	11.75	16.31	21.40	20.00
June	15.00	10.45	12.15	17.31	20.00	20.00
July	15.75	12.00	12.25	16.75	20.00	20.00
August	16.55	13.35	12.25	16.88	20.00	20.00
September	14.38	13.00	14.50	17.13	20.00	20.00
October	13.18	12.25	16.87	17.75	20.00	20.00
November	11.65	12.60	15.65	18.00	20.00	20.00
December	12.12	12.50	14.50	19.13	20.00	20.00
Average	15.04	12.01	13.34	16.28	20.21	20.00

* Changed from gross ton basis April 30, 1941.

The Iron Age

No. 1 Machinery Cast, at Cincinnati, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$17.14	$10.00	$7.55	$9.50	$10.25	$11.37
February	17.24	10.00	6.50	9.50	9.94	11.75
March	17.19	10.00	6.50	10.00	9.19	12.40
April	17.19	10.00	6.50	10.00	8.75	12.19
May	17.19	10.00	6.75	9.45	8.87	11.50
June	17.19	8.50	7.13	9.00	9.06	11.20
July	17.19	8.00	8.75	9.00	9.10	11.19
August	17.05	7.50	9.50	8.88	9.94	12.43
September	16.96	8.00	9.50	8.75	10.00	13.60
October	16.92	8.25	9.50	8.75	10.50	14.00
November	16.57	8.25	9.12	8.88	10.50	14.00
December	16.52	8.25	9.19	9.85	10.90	15.12
Average	17.03	8.90	8.04	9.30	9.75	12.56

	1937	1938	1939	1940	1941	1942
January	$15.75	$11.25	$13.75	$17.65	$22.75	$20.00
February	16.12	10.87	13.75	16.69	22.50	20.00
March	17.30	11.05	14.38	16.25	*22.50	20.00
April	17.37	10.62	13.56	16.05	.....	20.00
May	14.44	10.25	12.00	16.88	.....	20.00
June	14.00	10.10	12.13	19.38	.....	20.00
July	14.87	11.75	12.25	18.65	.....	20.00
August	16.25	12.65	12.80	18.75	.....	20.00
September	14.25	12.31	15.38	20.12	*22.50	20.00
October	13.38	12.31	19.55	20.55	22.50	20.00
November	11.85	13.15	18.88	21.00	22.50	20.00
December	10.75	13.88	17.75	22.50	22.50	20.00
Average	14.69	11.68	14.68	18.71	.....	20.00

* In transition from open market quotations to official OPA price maximums, this grade not quoted. However in action in September, the maximum schedules were revised by OPA to include this grade as "No. 1 machinery cast, drop broken, 150 lb. and under."

The Iron Age

Scrap Rails
2 ft. and under per gross ton f.o.b. Pittsburgh

	1937	1938	1939	1940	1941	1942
January	$22.75	$18.25	$17.75	$22.75	$26.75	$24.25
February	22.75	18.75	18.25	21.00	.....	24.25
March	26.75	17.75	18.50	21.00	26.75	24.25
April	25.25	17.75	18.25	21.50	19.75*	24.25
May	25.25	16.75	17.25	22.75	19.75	24.25
June	24.25	15.75	17.75	25.25	24.25**	24.25
July	25.75	16.25	17.75	22.75	24.25	24.25
August	25.75	16.75	19.25	22.75	24.25	24.25
September	22.75	17.25	26.25	25.75	24.25	24.25
October	20.25	17.25	26.75	26.75	24.25	24.25
November	18.25	17.25	22.75	27.25	24.25	24.25
December	18.25	17.25	22.75	27.25	24.25	24.25
Average	23.25	17.21	20.93	23.89	23.88	24.25

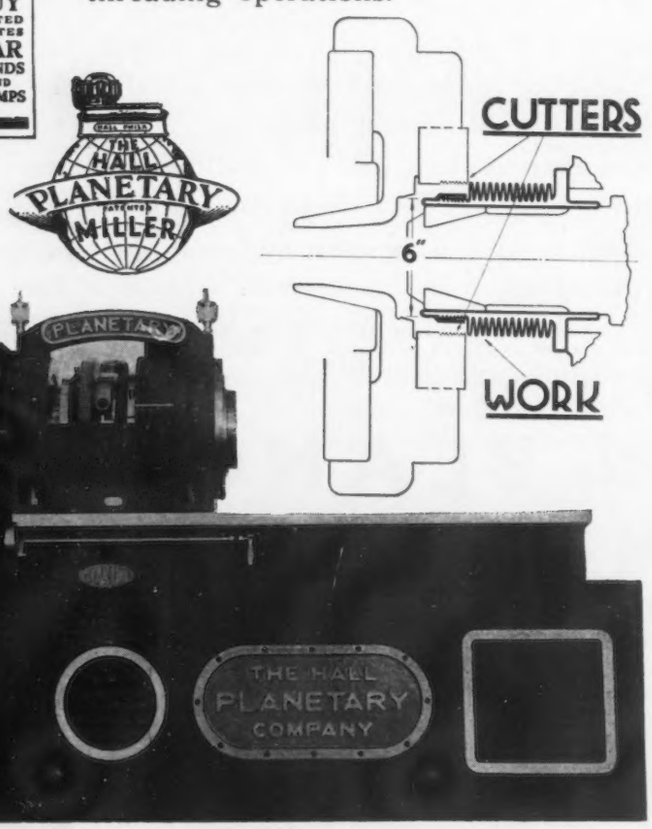
* OPA ceiling price.
** Readjusted OPA ceiling price at Pittsburgh.

PLANATHREADING

Milling the thread on airplane cylinder sleeves! This thread and pilot diameter must be held in true relationship and size. They are so held by Planathreading.

THE TIME IS SIX MINUTES

Let Planathreading do your accurate threading operations.



HALL PLANETARY CO.
FOX & ABBOTSFORD AVE., PHILADELPHIA, PA.

Spiegeleisen (19 to 21 Per Cent), Gross Ton, at Furnace

	1929	1932	1933	1934	1935	1936
January	$31.00	$26.00	$24.00	$27.00	$26.00	$26.00
February	31.00	26.00	24.00	27.00	26.00	26.00
March	31.00	26.00	24.00	26.50	26.00	26.00
April	31.00	26.00	24.00	26.00	26.00	26.00
May	31.00	26.00	24.00	26.00	26.00	26.00
June	31.00	25.75	24.00	26.00	26.00	26.00
July	31.00	25.00	27.00	26.00	26.00	26.00
August	31.00	25.00	27.00	26.00	26.00	26.00
September	31.00	25.00	27.00	26.00	26.00	26.00
October	31.00	25.00	27.00	26.00	26.00	26.00
November	31.00	24.40	27.00	26.00	26.00	26.00
December	31.00	24.00	27.00	26.00	26.00	26.00
Average	31.00	25.35	25.50	26.21	26.00	26.00

	1937	1938	1939	1940	1941	1942
January	$26.00	$33.00	$28.00	$32.00	$36.00	$36.00
February	26.00	33.00	28.00	32.00	36.00	36.00
March	28.40	33.00	28.00	32.00	36.00	36.00
April	30.00	33.00	28.00	32.00	36.00	36.00
May	32.25	33.00	28.00	32.00	36.00	36.00
June	33.00	33.00	28.00	34.40	36.00	36.00
July	33.00	28.00	28.00	36.00	36.00	36.00
August	33.00	28.00	28.00	36.00	36.00	36.00
September	33.00	28.00	31.00	36.00	36.00	36.00
October	33.00	28.00	32.00	36.00	36.00	36.00
November	33.00	28.00	32.00	36.00	36.00	36.00
December	33.00	28.00	32.00	36.00	36.00	36.00
Average	31.14	30.50	29.25	34.20	36.00	36.00

The Iron Age

50 Per Cent Ferrosilicon, Carloads, Gross Ton, Delivered East of Mississippi River

	1929	1932	1933	1934	1935	1936
January	$83.50	$77.50	$74.50	$77.50	$77.50	$77.50
February	83.50	77.50	74.50	77.50	77.50	77.50
March	83.50	77.50	74.50	77.50	77.50	77.50
April	83.50	77.50	74.50	77.50	77.50	77.50
May	83.50	77.50	74.50	77.50	77.50	77.50
June	83.50	77.50	74.50	77.50	77.50	77.50
July	83.50	77.50	74.50	77.50	77.50	69.50
August	83.50	77.50	74.50	77.50	77.50	69.50
September	83.50	77.50	74.50	77.50	77.50	69.50
October	83.50	77.50	74.50	77.50	77.50	69.50
November	83.50	77.50	74.50	77.50	77.50	69.50
December	83.50	77.50	74.50	77.50	77.50	69.50
Average	83.50	77.50	74.50	77.50	77.50	73.50

	1937	1938	1939	1940	1941	1942
January	$69.50	$69.50	$69.50	$69.50	$74.50	$74.50
February	69.50	69.50	69.50	69.50	74.50	74.50
March	69.50	69.50	69.50	69.50	74.50	74.50
April	69.50	69.50	69.50	69.50	74.50	74.50
May	69.50	69.50	69.50	69.50	74.50	74.50
June	69.50	69.50	69.50	72.00	74.50	74.50
July	69.50	69.50	69.50	74.50	74.50	74.50
August	69.50	69.50	69.50	74.50	74.50	74.50
September	69.50	69.50	69.50	74.50	74.50	74.50
October	69.50	69.50	69.50	74.50	74.50	74.50
November	69.50	69.50	69.50	74.50	74.50	74.50
December	69.50	69.50	69.50	74.50	74.50	74.50
Average	69.50	69.50	69.50	72.11	74.50	74.50

The Iron Age

Cast Iron Pipe at New York, Net Ton

6-in. and Larger

	1929	1932	1933	1934	1935	1936
January	$39.60	$30.20	$35.20	$43.00	$45.00	$45.20
February	39.35	29.70	35.30	43.00	45.00	45.20
March	38.60	28.40	35.30	43.00	45.00	45.20
April	37.40	28.20	35.30	43.00	45.00	45.20
May	35.85	28.20	35.30	43.00	45.00	45.20
June	35.10	28.20	38.30	44.00	45.15	45.20
July	33.20	28.73	38.30	45.00	45.20	45.90
August	33.60	31.10	38.30	45.00	45.20	45.90
September	33.60	31.30	38.30	45.00	45.20	45.90
October	34.60	33.30	38.00	45.00	45.20	45.90
November	34.60	33.30	43.00	45.00	45.20	45.90
December	34.60	34.30	43.00	45.00	45.20	47.90
Average	35.84	30.41	37.81	44.08	45.11	45.71

	1937	1938	1939	1940	1941	1942
January	$48.00	$53.00	$49.00	$52.20	$52.20	$52.20
February	48.00	53.00	49.00	52.20	52.20	52.20
March	51.00	53.00	49.00	52.20	52.20	52.20
April	53.00	53.00	49.00	52.20	52.20	52.20
May	53.00	53.00	49.00	52.20	52.20	52.20
June	53.00	52.20	49.00	52.20	52.20	52.20
July	53.00	49.00	49.00	52.20	52.20	52.20
August	53.00	49.00	49.00	52.20	52.20	52.20
September	53.00	49.00	49.00	52.20	52.20	52.20
October	53.00	49.00	52.20	52.20	52.20	52.20
November	53.00	49.00	52.20	52.20	52.20	52.20
December	53.00	49.00	52.20	52.20	52.20	52.20
Average	52.00	50.93	49.80	52.20	52.20	52.20

December 1942 price does not reflect the 3% freight tax.

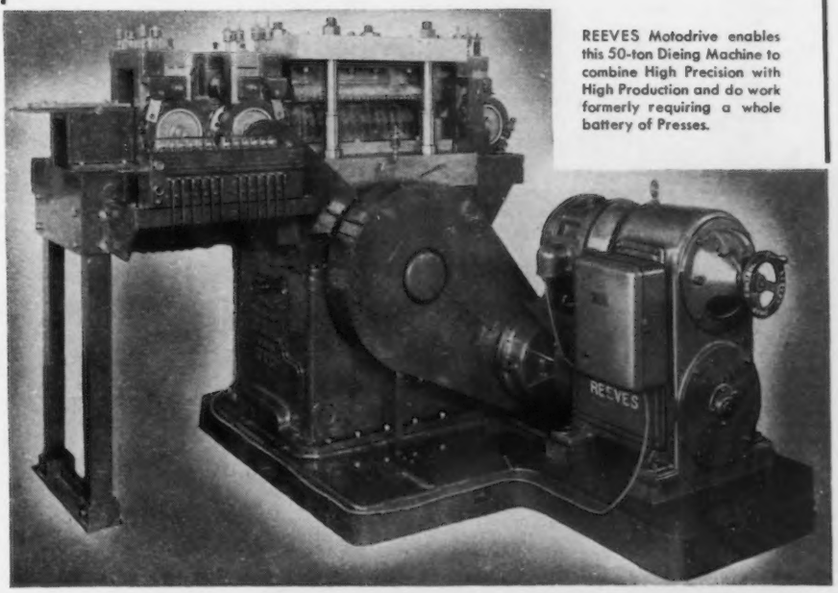
Ferromanganese (80 Per Cent), Gross Ton, at Seaboard

	1929	1932	1933	1934	1935	1936
January	$105.00	$75.00	$68.00	$85.00	$85.00	$75.00
February	105.00	75.00	68.00	85.00	85.00	75.00
March	105.00	75.00	68.00	85.00	85.00	75.00
April	105.00	75.00	68.00	85.00	85.00	75.00
May	105.00	75.00	68.00	85.00	85.00	75.00
June	105.00	68.00	68.00	85.00	85.00	75.00
July	105.00	68.00	82.00	85.00	85.00	75.00
August	105.00	68.00	82.00	85.00	85.00	75.00
September	105.00	68.00	82.00	85.00	85.00	75.00
October	105.00	68.00	82.00	85.00	85.00	75.00
November	105.00	68.00	82.00	85.00	85.00	80.00
December	105.00	68.00	82.00	85.00	85.00	80.00
Average	105.00	70.92	75.00	85.00	85.00	75.83

	1937	1938	1939	1940	1941	1942
January	$80.00	$102.50	$85.00	$100.00	$120.00	$120.00
February	80.00	102.50	80.00	100.00	120.00	120.00
March	89.00	102.50	80.00	100.00	120.00	120.00
April	95.00	102.50	80.00	100.00	120.00	120.00
May	100.62	102.50	80.00	100.00	120.00	135.00
June	102.50	102.50	80.00	110.00	120.00	135.00
July	102.50	92.50	80.00	120.00	120.00	135.00
August	102.50	92.50	80.00	120.00	120.00	135.00
September	102.50	92.50	95.00	120.00	120.00	135.00
October	102.50	92.50	100.00	120.00	120.00	135.00
November	102.50	92.50	100.00	120.00	120.00	135.00
December	102.50	92.50	100.00	120.00	120.00	135.00
Average	96.84	97.50	86.67	110.84	120.00	130.00

Intricate Stampings

AT ANY SPEED FROM 200 TO 600 STROKES PER MINUTE . . .



REEVES Motodrive enables this 50-ton Dieing Machine to combine High Precision with High Production and do work formerly requiring a whole battery of Presses.

★ ★ ★ This REEVES-equipped Henry & Wright 50-ton Dieing Machine produces, complete in one stroke, intricate stampings that formerly required a whole battery of presses. In regular and special models these dieing machines are producing an endless variety of stampings for airplane and munitions parts and other war work—combining high precision with high production. The REEVES Motodrive, which combines motor and speed varying mechanism, permits any speed from 200 to 600 strokes per minute, according to the size, shape and kind of material being processed. Speeds are quickly and accurately changed by turning the REEVES handwheel—without stopping the machine. REEVES variable speed drives are standard equipment on 1,440 different makes of machines. For an installation on any machine now engaged in vital war production, write us. Send for Catalog-Manual IG-419.

REEVES PULLEY COMPANY, COLUMBUS, INDIANA

REEVES *Accurate Variable* SPEED CONTROL

Steel Ingot Production

Open Hearth, Bessemer and Electric Ingots and Steel for Castings—Net Tons

For Data Previous to 1917, See Statistical Supplement, THE IRON AGE, Jan. 4, 1940

Source: American Iron and Steel Institute

	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930
January	2,998,947	4,120,565	3,974,213	2,832,150	2,129,686	4,325,457	4,107,080	4,719,919	4,656,029	4,302,172	4,531,172	5,115,195	4,288,212
February	3,094,059	3,586,108	3,836,328	2,248,923	2,332,217	3,909,643	4,305,501	4,223,613	4,264,863	4,327,341	4,590,842	4,920,348	4,579,761
March	4,232,541	3,529,865	4,417,344	2,019,465	3,168,503	4,579,489	4,733,607	4,721,111	5,035,081	5,148,330	5,117,384	5,760,878	4,828,571
April	4,304,701	2,969,604	3,532,623	1,560,522	3,267,086	4,463,564	3,767,877	4,033,752	4,626,271	4,685,249	4,888,226	5,626,610	4,664,182
May	4,473,198	2,557,668	3,860,482	1,627,229	3,623,434	4,748,038	2,970,710	3,888,883	4,425,910	4,594,340	4,776,766	6,008,754	4,520,520
June	4,195,889	2,942,435	3,991,068	1,289,861	3,520,973	4,242,308	2,324,411	3,606,900	4,207,512	3,968,129	4,250,736	5,573,076	3,879,960
July	4,236,970	3,325,559	3,752,903	1,032,726	3,324,009	3,976,776	2,112,991	3,471,854	4,095,783	3,637,255	4,320,783	5,513,546	3,316,654
August	4,196,207	3,640,994	4,017,502	1,462,971	2,959,784	4,161,827	2,872,652	3,850,644	4,492,374	3,971,467	4,744,291	5,614,144	3,473,898
September	4,351,304		4,016,322	1,510,108	3,172,549	3,780,066	3,181,798	3,927,822	4,409,463	3,710,754	4,709,416	5,146,744	3,223,766
October	4,561,598	11,357,194	4,038,323	2,078,382	3,838,975	4,028,163	3,516,891	4,377,214	4,591,053	3,764,573	5,279,460	5,154,063	3,055,972
November	4,165,018		3,533,112	2,133,903	3,861,539	3,529,560	3,512,087	4,393,068	4,175,502	3,549,711	4,844,460	4,002,365	2,510,820
December	4,071,867		3,133,690	1,834,504	3,715,317	3,224,324	4,016,316	4,469,629	3,906,230	3,604,731	4,562,175	3,299,786	2,246,742
Total	48,882,299	38,029,992	46,103,910	21,630,744	38,914,072	48,969,215	41,421,921	49,684,409	52,886,071	49,264,052	56,615,711	61,735,509	44,589,058

	1931	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942
January	2,852,540	1,685,665	2,157,745	2,276,596	3,279,411	3,474,353	5,398,326	1,984,815	3,663,004	5,764,723	6,928,085	7,124,922
February	2,892,154	1,681,421	1,221,664	2,521,472	3,169,849	3,379,587	5,050,824	1,942,795	3,448,120	4,525,797	6,237,900	6,521,056
March	3,468,208	1,627,030	1,022,675	3,190,040	3,273,848	3,810,436	5,970,247	2,293,884	3,929,387	4,389,183	7,131,641	7,392,911
April	3,141,887	1,429,848	1,531,813	3,346,922	3,017,120	4,494,782	5,801,540	2,196,413	3,431,600	4,100,474	6,756,949	7,122,313
May	2,897,385	1,277,302	2,250,236	3,875,202	3,009,189	4,614,529	5,894,260	2,061,169	3,372,636	4,967,782	7,053,238	7,386,890
June	2,416,078	1,036,102	2,919,687	3,487,612	2,580,723	4,543,888	4,787,710	1,868,848	3,606,729	5,657,443	6,800,730	7,022,155
July	2,143,351	915,738	3,607,288	1,697,879	2,591,191	4,473,940	5,212,832	2,259,677	3,648,639	5,724,625	6,821,682	7,148,824
August	1,949,462	961,153	3,260,279	1,574,649	3,331,707	4,782,442	5,580,683	2,903,805	4,341,726	6,186,383	7,000,957	7,233,451
September	1,754,817	1,125,892	2,599,370	1,446,551	3,227,815	4,744,841	4,907,592	3,029,736	4,881,601	6,056,246	6,819,706	7,067,084
October	1,805,653	1,233,957	2,373,729	1,689,272	3,590,878	5,182,430	3,881,819	3,554,912	6,223,126	6,644,542	7,242,683	7,584,864
November	1,807,315	1,171,710	1,731,930	1,836,008	3,599,619	4,941,014	2,464,793	4,072,676	6,292,322	6,469,107	6,969,987	7,184,560
December	1,477,529	977,389	2,047,780	2,239,126	3,511,636	5,056,843	1,685,273	3,583,253	5,958,893	6,495,357	7,163,999	.....
Total	28,606,379	15,123,207	25,724,196	29,181,329	38,182,986	53,499,085	56,635,899	31,751,983	52,797,783	66,981,662	82,927,557	*78,789,030

* Eleven months total.

ANY METAL ANY PERFORATION

The Harrington & King PERFORATING Co.

5657 FILLMORE STREET—CHICAGO, ILL.
New York Office, 114 Liberty Street

Steel Ingot Production

Per Cent of Capacity

Source: American Iron and Steel Institute

	1924	1925	1926	1927	1928	1929†
January	72.48	80.73	87.09	77.94	80.33	86.56
February	81.30	80.00	88.35	86.82	87.09	92.21
March	83.54	80.75	94.18	93.27	90.73	97.48
April	68.65	71.25	89.36	87.65	89.49	98.32
May	52.42	66.52	82.79	83.23	84.69	101.66
June	42.36	63.72	81.27	74.24	77.82	97.38
July	37.37	59.50	76.78	66.04	76.78	93.51
August	50.69	65.86	84.03	71.95	84.11	95.00
September	66.07	69.54	85.37	69.58	86.42	90.14
October	62.05	74.87	85.88	68.20	93.60	87.22
November	63.99	77.59	80.65	66.41	88.69	69.94
December	71.02	76.62	73.23	65.45	81.07	55.96
Average	61.94	72.20	84.05	75.83	85.05	88.76

	1931	1932	1933	1934	1935	1936
January	44.59	25.88	17.76	34.32	49.21	52.46
February	50.07	27.62	20.75	42.10	52.68	54.61
March	54.21	24.98	15.68	48.09	49.12	57.54
April	50.71	22.67	24.26	52.10	46.75	70.09
May	45.29	19.61	34.51	58.42	45.15	69.68
June	39.00	16.42	46.24	54.29	39.99	70.85
July	33.58	14.09	55.45	25.65	38.97	67.71
August	30.47	14.76	50.00	23.74	49.99	72.22
September	28.39	17.89	41.26	22.57	50.13	74.16
October	28.22	18.94	36.40	25.46	53.88	76.28
November	29.17	18.57	27.43	28.58	55.77	77.05
December	23.15	15.04	31.48	33.83	52.81	76.83
Average	37.99	19.67	33.52	37.37	48.68	68.45

	1937	1938	1939	1940	1941	1942
January	81.32	29.14	52.69	83.40	96.90	94.7
February	84.26	31.59	54.93	70.00	96.60	96.0
March	89.93	33.67	56.52	63.50	99.70	98.2
April	90.24	33.70	50.97	61.20	97.60	97.7
May	88.79	30.26	48.51	71.80	98.70	98.2
June	74.47	28.33	53.57	84.50	98.20	96.4
July	78.37	33.25	52.60	83.00	93.40	94.5
August	83.71	42.63	62.45	89.50	95.70	95.4
September	76.19	46.03	72.68	90.60	96.40	96.5
October	58.23	52.19	89.52	96.10	99.00	100.1
November	38.18	61.74	93.46	96.60	98.30	97.9
December	25.34	52.72	95.91	94.10	98.10	....
Average	72.33	39.60	64.53	82.10	97.40	*96.9

* Eleven months average.

Finished Steel Composite Price

(Cents per lb.)

Source: THE IRON AGE

• • • **Weighted average of** THE IRON AGE quotations on following steel items: Hot rolled and cold rolled strip, bars, plates, shapes, hot rolled and cold rolled sheets, wire rails and pipe. The composite was revised in 1941 to obtain greater sensitivity in reflecting price changes. This revision was described in detail in issue of Aug. 28, 1941, p. 92. Averages on the old basis for previous years were published in the Annual Statistical Supplement, Jan. 4, 1940.

	1929	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941	1942
January	2.27758	1.851549	1.83017	1.95757	2.06492	2.07642	2.32263	2.58414	2.35367	2.30467	2.30467	2.30467
February	2.27758	1.842512	1.81151	1.95757	2.06492	2.06513	2.32263	2.58084	2.35367	2.30467	2.30467	2.30467
March	2.27623	1.852212	1.80821	1.95757	2.06492	2.05463	2.53185	2.57754	2.35367	2.30467	2.30467	2.30467
April	2.30373	1.891812	1.77951	2.00659	2.06492	2.06220	2.58414	2.57754	2.35367	2.26651	2.30467	2.30467
May	2.30723	1.890912	1.76994	2.15367	2.06492	2.06220	2.58414	2.56939	2.30807	2.30467	2.30467	2.30467
June	2.31773	1.888112	1.78578	2.15367	2.06492	2.06680	2.58414	2.51300	2.28297	2.30467	2.30467	2.30467
July	2.31213	1.891962	1.84089	2.10667	2.06492	2.13890	2.58414	2.35944	2.28297	2.30467	2.30467	2.30467
August	2.29423	1.889002	1.85084	2.06492	2.06492	2.13890	2.58414	2.35944	2.28297	2.30467	2.30467	2.30467
September	2.28225	1.88308	1.87877	2.06492	2.06492	2.14554	2.58414	2.35655	2.28297	2.30467	2.30467	2.30467
October	2.26950	1.87324	1.95473	2.06492	2.07642	2.17210	2.58414	2.31964	2.28297	2.30467	2.30467	2.30467
November	2.26498	1.86553	1.94737	2.06492	2.07642	2.17210	2.58414	2.35367	2.28837	2.30467	2.30467	2.30467
December	2.27750	1.86053	1.95757	2.06492	2.07642	2.26276	2.58414	2.35367	2.30467	2.30467	2.30467	2.30467
Average	2.28839	1.87337	1.85127	2.05149	2.06779	2.11814	2.53620	2.45874	2.31088	2.27287	2.30467	2.30467

The Iron Age

Plates at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	1.90	1.50	1.60	1.70	1.80	1.80
February	1.90	1.50	1.60	1.70	1.80	1.80
March	1.90	1.52	1.60	1.70	1.80	1.80
April	1.95	1.60	1.55	1.74	1.80	1.80
May	1.95	1.60	1.50	1.85	1.80	1.80
June	1.95	1.60	1.53	1.85	1.80	1.80
July	1.95	1.60	1.60	1.81	1.80	1.90
August	1.95	1.60	1.60	1.80	1.80	1.90
September	1.95	1.60	1.60	1.80	1.80	1.90
October	1.94	1.60	1.70	1.80	1.80	1.90
November	1.90	1.60	1.70	1.80	1.80	1.90
December	1.90	1.60	1.70	1.80	1.80	1.90
Average	1.93	1.57	1.61	1.78	1.80	1.85

	1937	1938	1939	1940	1941	1942
January	2.05	2.25	2.10	2.10	2.10	2.10
February	2.05	2.25	2.10	2.10	2.10	2.10
March	2.21	2.25	2.10	2.10	2.10	2.10
April	2.25	2.25	2.10	2.10	2.10	2.10
May	2.25	2.25	2.10	2.10	2.10	2.10
June	2.25	2.22	2.10	2.10	2.10	2.10
July	2.25	2.10	2.10	2.10	2.10	2.10
August	2.25	2.10	2.10	2.10	2.10	2.10
September	2.25	2.10	2.10	2.10	2.10	2.10
October	2.25	2.10	2.10	2.10	2.10	2.10
November	2.25	2.10	2.10	2.10	2.10	2.10
December	2.25	2.10	2.10	2.10	2.10	2.10
Average	2.21	2.17	2.10	2.10	2.10	2.10

The Iron Age

Hot-Rolled Sheets at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	2.10	1.75	1.62	1.75	1.85	1.85
February	2.10	1.75	1.60	1.75	1.85	1.85
March	2.10	1.71	1.55	1.75	1.85	1.85
April	2.10	1.70	1.55	1.81	1.85	1.85
May	2.13	1.70	1.44	2.00	1.85	1.85
June	2.20	1.70	1.50	2.00	1.85	1.87
July	2.14	1.70	1.65	1.88	1.85	1.95
August	2.10	1.70	1.65	1.85	1.85	1.95
September	2.10	1.70	1.68	1.85	1.85	1.95
October	2.10	1.70	1.75	1.85	1.85	1.95
November	2.10	1.70	1.75	1.85	1.85	1.95
December	2.18	1.70	1.75	1.85	1.85	2.15
Average	2.12	1.71	1.62	1.85	1.85	1.92

	1937	1938	1939	1940	1941	1942
January	2.15	2.40	2.15	2.10	2.10	2.10
February	2.15	2.40	2.15	2.10	2.10	2.10
March	2.35	2.40	2.15	2.10	2.10	2.10
April	2.40	2.40	2.15	2.10	2.10	2.10
May	2.40	2.38	2.06	1.98	2.10	2.10
June	2.40	2.27	2.00	2.10	2.10	2.10
July	2.40	2.15	2.00	2.10	2.10	2.10
August	2.40	2.15	2.00	2.10	2.10	2.10
September	2.40	2.15	2.00	2.10	2.10	2.10
October	2.40	2.03	2.00	2.10	2.10	2.10
November	2.40	2.15	2.02	2.10	2.10	2.10
December	2.40	2.15	2.10	2.10	2.10	2.10
Average	2.35	2.25	2.06	2.09	2.10	2.10

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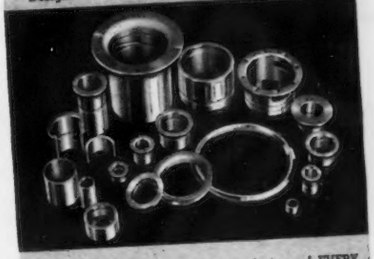

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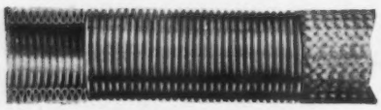
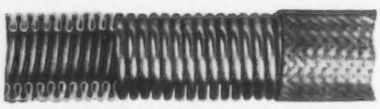


RW-80 Unbraided ——— RW-81 Braided

Rex-Weld Hose—Helical Corrugations



RW-90 Unbraided ——— RW-91 Braided

General Data

	STEEL	BRONZE
Sizes	To 4" I.D.	To 4" I.D.
Pressures	To 14,500 p.s.i.	To 14,500 p.s.i.
Temperatures	To 1000° F	To 450° F.
Lengths	To 50′	To 50′

Use Chart

	*STEEL	BRONZE
Saturated Steam		✓
Superheated Steam	✓	
Sulphur Bearing Oil	✓	
Oxygen		✓
Ammonia	✓	
Carbon Dioxide	✓	
Sulphur Bearing Grease	✓	
Critical Vibration		✓
Non-Sparking		✓

Protective Coatings Can Be Applied for Corrosion Protection (To Conserve Critical Copper Bearing Alloys).

Couplings: REX-TITE Mechanical (Re-attachable) Couplings; Solder Couplings; Brazed and Welded Couplings and Flange Assemblies for Rex-Weld Flexible Metal Hose.

Ask for Engineering Recommendations

CHICAGO METAL HOSE CORPORATION

General Offices: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Ill.

Tin Plate at Pittsburgh, Dollars a Base Box

	1929	1932	1933	1934	1935	1936
January	$5.35	$4.75	$4.25	$5.25	$5.25	$5.25
February	5.35	4.75	4.25	5.25	5.25	5.25
March	5.35	4.75	4.25	5.25	5.25	5.25
April	5.35	4.75	4.25	5.25	5.25	5.25
May	5.35	4.75	4.25	5.25	5.25	5.25
June	5.35	4.75	4.25	5.25	5.25	5.25
July	5.35	4.75	4.25	5.25	5.25	5.25
August	5.35	4.75	4.25	5.25	5.25	5.25
September	5.35	4.75	4.65	5.25	5.25	5.25
October	5.35	4.75	4.65	5.25	5.25	5.25
November	5.35	4.55	4.65	5.25	5.25	5.25
December	5.35	4.25	5.25	5.25	5.25	5.25
Average	5.35	4.69	4.43	5.25	5.25	5.25

	1937	1938	1939	1940	1941	1942
January	$4.85	$5.35	$5.00	$5.00	$5.00	$5.00
February	4.85	5.35	5.00	5.00	5.00	5.00
March	4.85	5.35	5.00	5.00	5.00	5.00
April	5.35	5.35	5.00	5.00	5.00	5.00
May	5.35	5.35	5.00	5.00	5.00	5.00
June	5.35	5.35	5.00	5.00	5.00	5.00
July	5.35	5.35	5.00	5.00	5.00	5.00
August	5.35	5.35	5.00	5.00	5.00	5.00
September	5.35	5.35	5.00	5.00	5.00	5.00
October	5.35	5.35	5.00	5.00	5.00	5.00
November	5.35	5.18	5.00	5.00	5.00	5.00
December	5.35	5.00	5.00	5.00	5.00	5.00
Average	5.22	5.31	5.00	5.00	5.00	5.00

The Iron Age

Cold-Finished Steel Bars at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	2.20	2.00	1.70	2.10	2.10	2.10
February	2.20	2.00	1.70	2.10	2.10	2.10
March	2.20	2.00	1.70	2.10	2.10	2.10
April	2.30	2.00	1.70	2.10	2.01	2.10
May	2.30	1.82	1.70	2.10	1.95	2.10
June	2.30	1.70	1.70	2.10	1.95	2.10
July	2.30	1.70	1.70	2.10	1.95	2.25
August	2.30	1.70	1.70	2.10	1.95	2.25
September	2.30	1.70	1.95	2.10	1.95	2.25
October	2.30	1.70	1.95	2.10	1.95	2.35
November	2.30	1.70	1.95	2.10	1.95	2.35
December	2.30	1.70	2.10	2.10	1.95	2.35
Average	2.28	1.81	1.80	2.10	1.99	2.20

	1937	1938	1939	1940	1941	1942
January	2.55	2.90	2.70	2.65	2.65	2.65
February	2.55	2.90	2.70	2.65	2.65	2.65
March	2.83	2.90	2.70	2.65	2.65	2.65
April	2.90	2.90	2.70	2.65	2.65	2.65
May	2.90	2.90	2.68	2.65	2.65	2.65
June	2.90	2.70	2.65	2.65	2.65	2.65
July	2.90	2.70	2.65	2.65	2.65	2.65
August	2.90	2.70	2.65	2.65	2.65	2.65
September	2.90	2.70	2.65	2.65	2.65	2.65
October	2.90	2.70	2.65	2.65	2.65	2.65
November	2.90	2.70	2.65	2.65	2.65	2.65
December	2.90	2.70	2.65	2.65	2.65	2.65
Average	2.84	2.78	2.67	2.65	2.65	2.65

The Iron Age

Steel Rails at Mill, Open-Hearth, Gross Ton

	1929	1932	1933	1934	1935	1936
January	$43.00	$43.00	$40.00	$36.37	$36.37	$36.37
February	43.00	43.00	40.00	36.37	36.37	36.37
March	43.00	43.00	40.00	36.37	36.37	36.37
April	43.00	43.00	40.00	36.37	36.37	36.37
May	43.00	43.00	40.00	36.37	36.37	36.37
June	43.00	43.00	40.00	36.37	36.37	36.37
July	43.00	43.00	40.00	36.37	36.37	36.37
August	43.00	43.00	40.00	36.37	36.37	36.37
September	43.00	43.00	40.00	36.37	36.37	36.37
October	43.00	42.25	39.55	36.37	36.37	36.37
November	43.00	40.00	36.38	36.37	36.37	36.37
December	43.00	40.00	36.38	36.37	36.37	39.00
Average	43.00	42.44	39.26	36.37	36.37	36.59

	1937	1938	1939	1940	1941	1942
January	$39.00	$42.50	$40.00	$40.00	$40.00	$40.00
February	39.00	42.50	40.00	40.00	40.00	40.00
March	41.80	42.50	40.00	40.00	40.00	40.00
April	42.50	42.50	40.00	40.00	40.00	40.00
May	42.50	42.50	40.00	40.00	40.00	40.00
June	42.50	42.50	40.00	40.00	40.00	40.00
July	42.50	42.50	40.00	40.00	40.00	40.00
August	42.50	42.50	40.00	40.00	40.00	40.00
September	42.50	41.25	40.00	40.00	40.00	40.00
October	42.50	40.00	40.00	40.00	40.00	40.00
November	42.50	40.00	40.00	40.00	40.00	40.00
December	42.50	40.00	40.00	40.00	40.00	40.00
Average	41.86	41.77	40.00	40.00	40.00	40.00

STATISTICAL

Cold-Rolled Sheets at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	4.10	2.90	2.35	2.75	2.95	2.95
February	4.10	2.80	2.25	2.75	2.95	2.95
March	4.10	2.86	2.30	2.75	2.95	2.95
April	4.10	2.90	2.30	2.85	2.95	2.95
May	4.10	2.89	2.34	3.15	2.95	2.95
June	4.10	2.85	2.29	3.15	2.95	2.95
July	4.10	2.85	2.40	2.99	2.95	3.05
August	4.08	2.81	2.47	2.95	2.95	3.05
September	4.00	2.75	2.75	2.95	2.95	3.05
October	4.00	2.65	2.75	2.95	2.95	3.05
November	4.00	2.63	2.75	2.95	2.95	3.05
December	3.98	2.65	2.75	2.95	2.95	3.25
Average	4.06	2.80	2.48	2.96	2.95	3.02

	1937	1938	1939	1940	1941	1942
January	3.25	3.55	3.20	3.05	3.05	3.05
February	3.25	3.50	3.20	3.05	3.05	3.05
March	3.49	3.45	3.20	3.05	3.05	3.05
April	3.55	3.45	3.20	2.93	3.05	3.05
May	3.55	3.43	3.11	3.05	3.05	3.05
June	3.55	3.32	3.05	3.05	3.05	3.05
July	3.55	3.20	3.05	3.05	3.05	3.05
August	3.55	3.20	3.05	3.05	3.05	3.05
September	3.55	3.20	3.05	3.05	3.05	3.05
October	3.55	3.08	3.05	3.05	3.05	3.05
November	3.55	3.20	3.05	3.05	3.05	3.05
December	3.55	3.20	3.05	3.05	3.05	3.05
Average	3.49	3.31	3.10	3.04	3.05	3.05

—The Iron Age—

Hot-Rolled Strip at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	1.80	1.41	1.45	1.75	1.85	1.85
February	1.80	1.40	1.45	1.75	1.85	1.85
March	1.80	1.40	1.45	1.75	1.85	1.85
April	1.90	1.40	1.45	1.81	1.85	1.85
May	1.90	1.40	1.49	2.00	1.85	1.85
June	1.90	1.41	1.55	2.00	1.85	1.85
July	1.90	1.45	1.60	1.88	1.85	1.95
August	1.90	1.45	1.64	1.85	1.85	1.95
September	1.97	1.45	1.68	1.85	1.85	1.95
October	1.90	1.45	1.75	1.85	1.85	1.95
November	1.90	1.45	1.75	1.85	1.85	1.95
December	1.90	1.45	1.75	1.85	1.85	2.11
Average	1.88	1.43	1.58	1.85	1.85	1.91

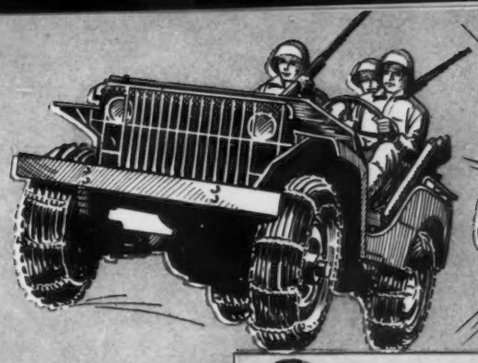
	1937	1938	1939	1940	1941	1942
January	2.15	2.40	2.15	2.10	2.10	2.10
February	2.15	2.40	2.15	2.10	2.10	2.10
March	2.35	2.40	2.15	2.10	2.10	2.10
April	2.40	2.40	2.15	1.98	2.10	2.10
May	2.40	2.38	2.06	2.10	2.10	2.10
June	2.40	2.27	2.00	2.10	2.10	2.10
July	2.40	2.15	2.00	2.10	2.10	2.10
August	2.40	2.15	2.00	2.10	2.10	2.10
September	2.40	2.15	2.00	2.10	2.10	2.10
October	2.40	2.03	2.00	2.10	2.10	2.10
November	2.40	2.15	2.02	2.10	2.10	2.10
December	2.40	2.15	2.10	2.10	2.10	2.10
Average	2.35	2.25	2.06	2.09	2.10	2.10

—The Iron Age—

Cold-Rolled Strip at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	2.85	1.92	1.88	2.40	2.60	2.60
February	2.85	1.90	1.80	2.40	2.60	2.60
March	2.80	1.96	1.80	2.40	2.60	2.60
April	2.75	2.00	1.80	2.50	2.60	2.60
May	2.75	2.00	1.88	2.80	2.60	2.60
June	2.75	2.00	2.00	2.80	2.60	2.60
July	2.75	2.00	2.19	2.64	2.60	2.60
August	2.75	2.00	2.25	2.60	2.60	2.60
September	2.75	1.92	2.29	2.60	2.60	2.60
October	2.75	1.90	2.40	2.60	2.60	2.60
November	2.75	2.00	2.40	2.60	2.60	2.60
December	2.75	2.00	2.40	2.60	2.60	2.80
Average	2.77	1.97	2.09	2.58	2.60	2.62

	1937	1938	1939	1940	1941	1942
January	2.85	3.20	2.95	2.80	2.80	2.80
February	2.85	3.20	2.95	2.80	2.80	2.80
March	3.13	3.20	2.95	2.80	2.80	2.80
April	3.20	3.20	2.95	2.68	2.80	2.80
May	3.20	3.18	2.86	2.80	2.80	2.80
June	3.20	3.07	2.80	2.80	2.80	2.80
July	3.20	2.95	2.80	2.80	2.80	2.80
August	3.20	2.95	2.80	2.80	2.80	2.80
September	3.20	2.95	2.80	2.80	2.80	2.80
October	3.20	2.83	2.80	2.80	2.80	2.80
November	3.20	2.95	2.80	2.80	2.80	2.80
December	3.20	2.95	2.80	2.80	2.80	2.80
Average	3.14	3.05	2.86	2.79	2.80	2.80



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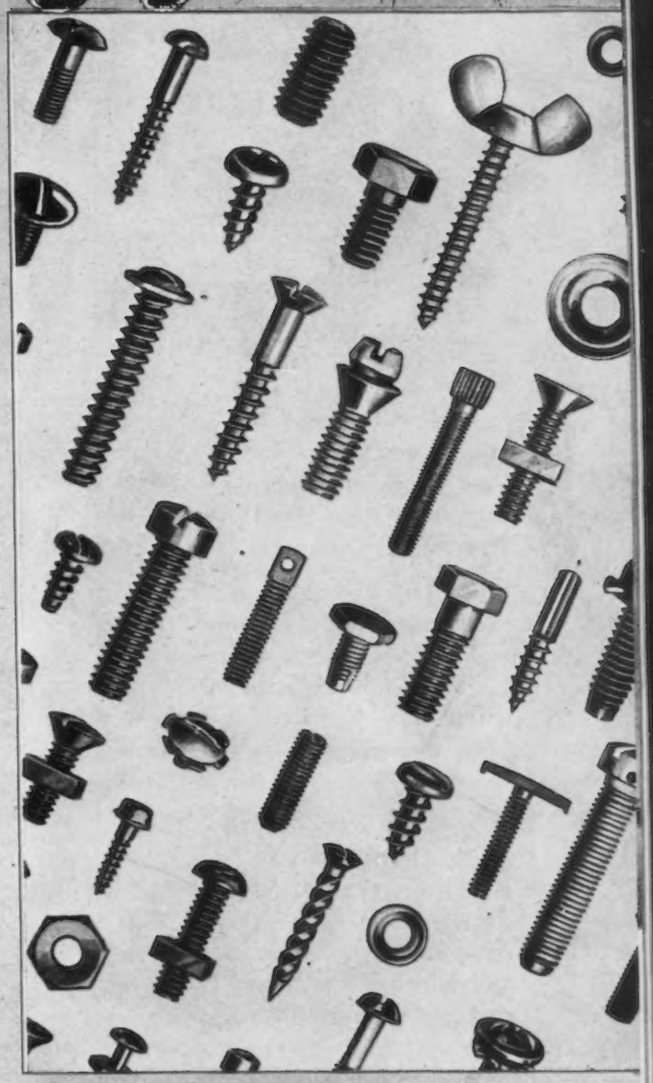
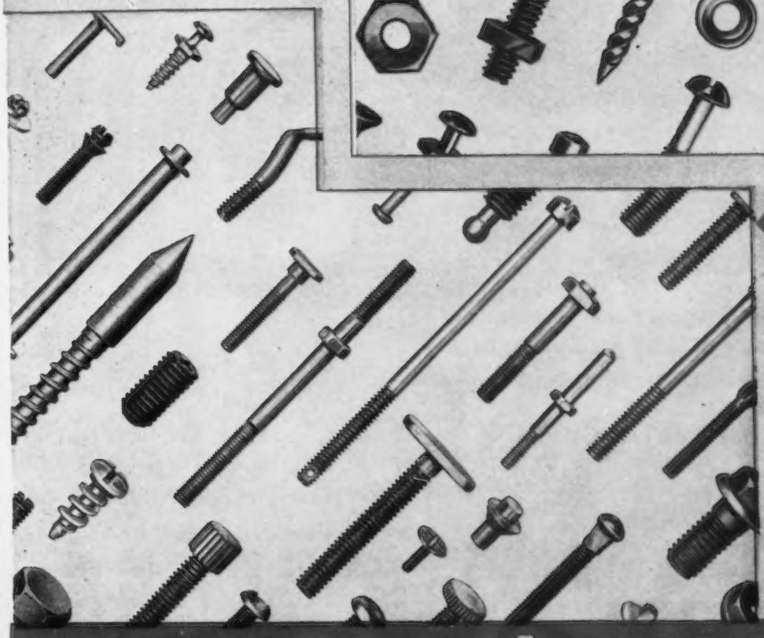
Like the speedy, rugged, indispensible "Jeep" and other mighty midgets of war, HOLTITE Screws, Bolts and allied fastenings are called upon to do jobs far out of proportion to their size. With strength beyond ordinary demands, HOLTITE time-tested fastenings can be used in any assembly with full assurance of faultless, enduring performance. Specify them on your next order.





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"I've found these STAR 'Moly'* High Speed Blades—hand *or* power—last just as long and cut even faster than other high speed blades they replace.

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Today's STAR "Moly"* High Speed is far ahead in steel analysis and heat treatment. It's only logical that the company which developed the first molybdenum blade, and has been making them and improving them ever since, today makes the best—STAR "Moly"* High Speed, easy to recognize by its all-over metallic finish.

"TRAINEE TROUBLE"?

Then give those new apprentices this free 20-page STAR book of hack saw knowledge. It helps speed work, save blades.

Ask for **"METAL CUTTING"**

TRADE MARK

CLEMSON BROS.
INCORPORATED
MIDDLETOWN, N. Y.

**T. M. Reg.—Blades bearing name "Moly" are made only by Clemson Bros., Inc. and affiliated companies.*

8183

No. 24 Gage Galvanized Sheets, at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	3.60	2.80	2.68	2.85	3.10	3.10
February	3.60	2.75	2.50	2.85	3.10	3.10
March	3.60	2.85	2.60	2.85	3.10	3.10
April	3.60	2.85	2.63	2.95	3.10	3.10
May	3.60	2.85	2.70	3.25	3.10	3.10
June	3.60	2.85	2.70	3.25	3.10	3.10
July	3.60	2.85	2.85	3.13	3.10	3.20
August	3.50	2.81	2.85	3.10	3.10	3.20
September	3.50	2.75	2.85	3.10	3.10	3.20
October	3.50	2.85	2.85	3.10	3.10	3.20
November	3.48	2.85	2.85	3.10	3.10	3.20
December	3.40	2.85	2.85	3.10	3.10	3.40
Average	3.55	2.83	2.74	3.05	3.10	3.17

	1937	1938	1939	1940	1941	1942
January	3.40	3.80	3.50	3.50	3.50	3.50
February	3.40	3.80	3.50	3.50	3.50	3.50
March	3.72	3.80	3.50	3.50	3.50	3.50
April	3.80	3.80	3.50	3.50	3.50	3.50
May	3.80	3.80	3.46	3.50	3.50	3.50
June	3.80	3.68	3.50	3.50	3.50	3.50
July	3.80	3.50	3.50	3.50	3.50	3.50
August	3.80	3.50	3.50	3.50	3.50	3.50
September	3.80	3.50	3.50	3.50	3.50	3.50
October	3.80	3.45	3.50	3.50	3.50	3.50
November	3.80	3.50	3.50	3.50	3.50	3.50
December	3.80	3.50	3.50	3.50	3.50	3.50
Average	3.73	3.64	3.50	3.50	3.50	3.50

The Iron Age

Standard Steel Pipe at Pittsburgh, Net Ton

Computed from list discounts, for carload lots; price for base size pipe, 1 to 3 in.; ¾ to 3 in. prior to April 13, 1931.

	1929	1932	1933	1934	1935	1936
January	$70.30	$64.84	$65.00	$61.75	$68.40	$68.40
February	70.30	64.84	65.00	61.75	68.40	64.98
March	70.30	64.84	65.00	61.75	68.40	61.80
April	70.30	64.84	58.00	63.41	68.40	61.00
May	70.30	64.84	58.00	68.40	68.40	61.00
June	70.30	64.84	58.00	68.40	68.40	61.00
July	70.30	64.84	61.75	68.40	68.40	61.00
August	70.30	64.84	61.75	68.40	68.40	61.00
September	70.30	65.00	61.75	68.40	68.40	61.00
October	70.30	65.00	61.75	68.40	68.40	61.00
November	70.30	65.00	61.75	68.40	68.40	61.00
December	70.30	65.00	61.75	68.40	68.40	61.00
Average	70.30	64.89	61.63	66.32	68.40	62.01

	1937	1938	1939	1940	1941	1942
January	$61.00	$71.00	$63.00	$63.00	$63.00	$63.00
February	61.00	71.00	63.00	63.00	63.00	63.00
March	69.00	71.00	63.00	63.00	63.00	63.00
April	71.00	71.00	63.00	63.00	63.00	63.00
May	71.00	71.00	63.00	63.00	63.00	63.00
June	71.00	71.00	63.00	63.00	63.00	63.00
July	71.00	63.00	63.00	63.00	63.00	63.00
August	71.00	63.00	63.00	63.00	63.00	63.00
September	71.00	63.00	63.00	63.00	63.00	63.00
October	71.00	63.00	63.00	63.00	63.00	63.00
November	71.00	63.00	63.00	63.00	63.00	63.00
December	71.00	63.00	63.00	63.00	63.00	63.00
Average	69.17	67.00	63.00	63.00	63.00	63.00

The Iron Age

High Speed Tool Steel Base Per Pound, Cents

	1937	1938	1939	1940	1941	1942
January	80.00	67.00	67.00	67.00	67.00	67.00
February	67.00	67.00	67.00	67.00	67.00	67.00
March	67.00	67.00	67.00	67.00	67.00	67.00
April	67.00	67.00	67.00	67.00	67.00	67.00
May	67.00	67.00	67.00	67.00	67.00	67.00
June	67.00	67.00	67.00	67.00	67.00	67.00
July	67.00	67.00	67.00	67.00	67.00	67.00
August	67.00	67.00	67.00	67.00	67.00	67.00
September	80.00	67.00	67.00	67.00	67.00	67.00
October	80.00	67.00	67.00	67.00	67.00	67.00
November	80.00	67.00	67.00	67.00	67.00	67.00
December	80.00	67.00	67.00	67.00	67.00	67.00
Average	70.10	67.00	67.00	67.00	67.00	67.00

Merchant Bars at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	1.90	1.50	1.60	1.75	1.80	1.85
February	1.90	1.50	1.60	1.75	1.80	1.85
March	1.90	1.52	1.60	1.75	1.80	1.85
April	1.95	1.60	1.60	1.79	1.80	1.85
May	1.95	1.60	1.60	1.90	1.80	1.85
June	1.95	1.60	1.60	1.90	1.80	1.85
July	1.95	1.60	1.60	1.82	1.80	1.95
August	1.95	1.60	1.60	1.80	1.80	1.95
September	1.94	1.60	1.60	1.80	1.80	1.97
October	1.90	1.60	1.75	1.80	1.85	2.05
November	1.90	1.60	1.75	1.80	1.85	2.05
December	1.90	1.60	1.75	1.80	1.85	2.05
Average	1.92	1.57	1.64	1.81	1.81	1.93

	1937	1938	1939	1940	1941	1942
January	2.20	2.45	2.25	2.15	2.15	2.15
February	2.20	2.45	2.25	2.15	2.15	2.15
March	2.40	2.45	2.25	2.15	2.15	2.15
April	2.45	2.45	2.25	2.15	2.15	2.15
May	2.45	2.45	2.19	2.15	2.15	2.15
June	2.45	2.41	2.15	2.15	2.15	2.15
July	2.45	2.25	2.15	2.15	2.15	2.15
August	2.45	2.25	2.15	2.15	2.15	2.15
September	2.45	2.25	2.15	2.15	2.15	2.15
October	2.45	2.25	2.15	2.15	2.15	2.15
November	2.45	2.25	2.15	2.15	2.15	2.15
December	2.45	2.25	2.15	2.15	2.15	2.15
Average	2.40	2.35	2.19	2.15	2.15	2.15

The Iron Age

Plain Wire, Base at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	2.50	2.20	2.16	2.20	2.30	2.30
February	2.50	2.20	2.10	2.20	2.30	2.30
March	2.50	2.20	2.10	2.20	2.30	2.30
April	2.50	2.20	2.10	2.23	2.30	2.40
May	2.50	2.20	2.10	2.30	2.30	2.40
June	2.50	2.20	2.10	2.30	2.30	2.40
July	2.50	2.20	2.10	2.30	2.30	2.40
August	2.43	2.20	2.10	2.30	2.30	2.40
September	2.40	2.20	2.10	2.30	2.30	2.40
October	2.40	2.20	2.10	2.30	2.30	2.50
November	2.40	2.20	2.10	2.30	2.30	2.50
December	2.40	2.20	2.20	2.30	2.30	2.60
Average	2.46	2.20	2.11	2.27	2.30	2.41

	1937	1938	1939	1940	1941	1942
January	2.60	2.90	2.60	2.60	2.60	2.60
February	2.60	2.90	2.60	2.60	2.60	2.60
March	2.84	2.90	2.60	2.60	2.60	2.60
April	2.90	2.90	2.60	2.60	2.60	2.60
May	2.90	2.90	2.60	2.60	2.60	2.60
June	2.90	2.84	2.60	2.60	2.60	2.60
July	2.90	2.60	2.60	2.60	2.60	2.60
August	2.90	2.60	2.60	2.60	2.60	2.60
September	2.90	2.60	2.60	2.60	2.60	2.60
October	2.90	2.60	2.60	2.60	2.60	2.60
November	2.90	2.60	2.60	2.60	2.60	2.60
December	2.90	2.60	2.60	2.60	2.60	2.60
Average	2.84	2.74	2.60	2.60	2.60	2.60

The Iron Age

Structural Shapes at Pittsburgh, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	1.90	1.50	1.60	1.70	1.80	1.80
February	1.90	1.50	1.60	1.70	1.80	1.80
March	1.90	1.52	1.60	1.70	1.80	1.80
April	1.95	1.60	1.60	1.74	1.80	1.80
May	1.95	1.60	1.60	1.85	1.80	1.80
June	1.95	1.60	1.60	1.85	1.80	1.80
July	1.95	1.60	1.60	1.81	1.80	1.90
August	1.95	1.60	1.60	1.80	1.80	1.90
September	1.95	1.60	1.60	1.80	1.80	1.90
October	1.90	1.60	1.70	1.80	1.80	1.90
November	1.90	1.60	1.70	1.80	1.80	1.90
December	1.90	1.60	1.70	1.80	1.80	1.90
Average	1.92	1.57	1.68	1.78	1.80	1.85

	1937	1938	1939	1940	1941	1942
January	2.05	2.25	2.10	2.10	2.10	2.10
February	2.05	2.25	2.10	2.10	2.10	2.10
March	2.21	2.25	2.10	2.10	2.10	2.10
April	2.25	2.25	2.10	2.10	2.10	2.10
May	2.25	2.25	2.10	2.10	2.10	2.10
June	2.25	2.22	2.10	2.10	2.10	2.10
July	2.25	2.10	2.10	2.10	2.10	2.10
August	2.25	2.10	2.10	2.10	2.10	2.10
September	2.25	2.10	2.10	2.10	2.10	2.10
October	2.25	2.10	2.10	2.10	2.10	2.10
November	2.25	2.10	2.10	2.10	2.10	2.10
December	2.25	2.10	2.10	2.10	2.10	2.10
Average	2.21	2.17	2.10	2.10	2.10	2.10

A new year ... a renewed faith

BEFORE us lies a new twelve months . . . a milestone in history which, we hope, will guide us to a fuller realization of America's way of life.

And to the extent that manpower and machinery and munitions co-ordinate, to that extent will the path to Victory be made secure. Latrobe, in line with Industry everywhere, dedicates this coming year to a renewed faith in American ideals and a renewed effort to maintain maximum production. Backed by traditional quality, Latrobe's trademark symbolizes in the months that lie ahead, as it has in the past, dependable tool steels for the essential tools of Victory!

HIGH-SPEED STEELS *FOR THE* TOOLS OF VICTORY

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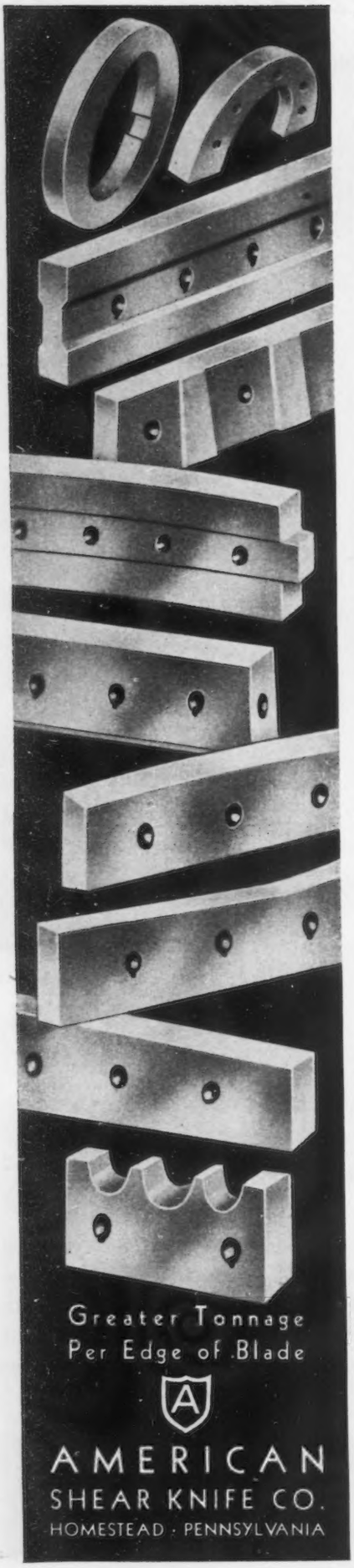

Stainless Steel Sheets No. 304 Base Per Pound, Cents

	1937	1938	1939	1940	1941	1942
January	35.00	36.00	36.00	36.00	36.00	36.00
February	35.00	36.00	36.00	36.00	36.00	36.00
March	36.00	36.00	36.00	36.00	36.00	36.00
April	36.00	36.00	36.00	36.00	36.00	36.00
May	36.00	36.00	36.00	36.00	36.00	36.00
June	36.00	36.00	36.00	36.00	36.00	36.00
July	36.00	36.00	36.00	36.00	36.00	36.00
August	36.00	36.00	36.00	36.00	36.00	36.00
September	36.00	36.00	36.00	36.00	36.00	36.00
October	36.00	36.00	36.00	36.00	36.00	36.00
November	36.00	36.00	36.00	36.00	36.00	36.00
December	36.00	36.00	36.00	36.00	36.00	36.00
Average	35.90	36.00	36.00	36.00	36.00	36.00

The Iron Age

Furnace Coke, Prompt Connellsville, Net Ton at Oven

	1929	1932	1933	1934	1935	1936
January	$2.75	$2.25	$1.75	$3.60	$3.85	$3.65
February	2.90	2.25	1.75	3.50	3.85	3.65
March	2.98	2.25	1.75	3.50	3.85	3.65
April	2.78	2.25	1.75	3.85	3.85	3.65
May	2.75	2.20	1.75	3.85	3.85	3.65
June	2.75	2.00	1.81	3.85	3.59	3.65
July	2.75	2.00	2.31	3.85	3.27	3.50
August	2.73	2.00	2.55	3.85	3.29	3.61
September	2.65	2.00	2.50	3.85	3.25	3.69
October	2.65	1.81	3.50	3.85	3.53	3.75
November	2.65	1.75	3.75	3.85	3.60	3.75
December	2.63	1.75	3.75	3.85	3.57	3.92
Average	2.75	2.04	2.41	3.79	3.61	3.68

	1937	1938	1939	1940	1941	1942
January	$4.00	$4.00	$3.75	$4.20	$5.50	$6.13
February	4.06	4.00	3.75	4.00	5.50	6.00
March	4.25	4.00	3.75	4.00	5.52	6.00
April	4.51	4.00	3.75	4.00	5.63	6.00
May	4.60	4.00	3.75	4.00	6.00	6.00
June	4.58	3.85	3.75	4.00	6.13	6.00
July	4.35	3.75	3.75	4.20	6.13	6.00
August	4.35	3.75	3.75	4.63	6.13	6.00
September	4.27	3.75	4.25	4.75	6.13	6.00
October	4.25	3.75	4.90	4.75	6.13	6.00
November	4.25	3.75	5.00	5.10	6.13	6.00
December	4.00	3.75	5.00	5.375	6.13	6.00
Average	4.29	3.86	4.09	4.42	5.92	6.01

The Iron Age

Foundry Coke, Prompt Connellsville, Net Ton at Oven

	1929	1932	1933	1934	1935	1936
January	$3.75	$3.50	$2.50	$4.25	$4.60	$4.25
February	3.75	3.50	2.50	4.25	4.60	4.25
March	3.75	3.50	2.50	4.25	4.60	4.25
April	3.75	3.50	2.50	4.60	4.60	4.25
May	3.75	3.10	2.50	4.60	4.60	4.25
June	3.75	3.00	2.56	4.60	4.15	4.25
July	3.75	3.00	2.94	4.60	3.88	4.00
August	3.75	2.90	3.15	4.60	4.00	4.00
September	3.75	2.75	3.25	4.60	4.00	4.05
October	3.75	2.75	4.05	4.60	4.20	4.25
November	3.75	2.75	4.25	4.60	4.25	4.25
December	3.50	2.69	4.25	4.60	4.15	4.40
Average	3.73	3.08	3.08	4.51	4.30	4.20

	1937	1938	1939	1940	1941	1942
January	$4.50	$5.00	$4.75	$5.50	$5.75	$6.88
February	4.50	5.00	4.75	5.31	5.75	6.88
March	4.50	5.00	4.75	5.25	5.85	6.88
April	5.00	5.00	4.75	5.25	5.82	6.88
May	5.25	5.00	4.75	5.25	6.72	6.88
June	5.25	4.85	4.75	5.25	6.88	6.88
July	5.00	4.75	4.75	5.25	6.88	6.88
August	5.00	4.75	4.75	5.25	6.88	6.88
September	5.00	4.75	5.12	5.25	6.88	6.88
October	5.00	4.75	5.65	5.25	6.88	6.88
November	5.00	4.75	5.75	5.625	6.88	6.88
December	5.00	4.75	5.75	5.75	6.88	6.88
Average	4.92	4.86	5.02	5.35	6.49	6.88

Electrolytic Copper, Conn. Valley, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	16.84	7.33	5.00	8.18	9.00	9.25
February	18.05	6.25	5.00	8.00	9.00	9.25
March	21.38	5.99	5.26	8.00	9.00	9.25
April	19.93	5.79	5.68	8.39	9.00	9.40
May	18.00	5.51	6.93	8.50	9.00	9.50
June	18.00	5.39	8.00	8.82	8.88	9.50
July	18.00	5.28	8.91	9.00	8.00	9.60
August	18.00	5.43	9.00	9.00	8.22	9.75
September	18.03	6.21	9.00	9.00	8.77	9.75
October	18.00	5.97	8.25	9.00	9.19	9.85
November	18.00	5.31	8.16	9.00	9.25	10.43
December	18.00	5.04	8.12	9.00	9.25	11.00
Average	18.35	5.79	7.28	8.66	8.88	9.71

	1937	1938	1939	1940	1941	1942
January	12.66	10.42	11.25	12.22	12.00	12.00
February	13.60	10.00	11.25	11.40	12.00	12.00
March	15.99	10.00	11.25	11.38	12.00	12.00
April	15.35	10.00	10.47	11.33	12.00	12.00
May	14.00	9.60	10.06	11.32	12.00	12.00
June	14.00	9.00	10.00	11.37	12.00	12.00
July	14.00	9.81	10.22	10.81	12.00	12.00
August	14.00	10.12	10.49	10.95	12.00	12.00
September	13.78	10.25	11.93	11.54	12.00	12.00
October	12.06	10.98	12.44	12.00	12.00	12.00
November	11.02	11.25	12.50	12.00	12.00	12.00
December	10.24	11.25	12.50	12.00	12.00	12.00
Average	13.39	10.22	11.20	11.53	12.00	12.00

The Iron Age

Zinc at New York, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	6.70	3.38	3.38	4.82	4.08	5.22
February	6.70	3.19	3.04	4.73	4.06	5.23
March	6.80	3.16	3.37	4.72	4.25	5.27
April	7.04	3.10	3.68	4.72	4.38	5.27
May	6.98	2.90	4.17	4.71	4.60	5.27
June	7.00	3.16	4.70	4.59	4.67	5.26
July	7.10	2.92	5.24	4.68	4.70	5.16
August	7.15	3.13	5.28	4.63	4.92	5.17
September	7.15	3.66	5.08	4.43	5.04	5.22
October	7.09	3.41	5.12	4.19	5.21	5.22
November	6.63	3.46	4.87	4.08	5.23	5.35
December	6.09	3.50	4.82	4.06	5.22	5.64
Average	6.87	3.25	4.40	4.51	4.70	5.27

	1937	1938	1939	1940	1941	1942
January	6.20	5.35	4.89	6.03	7.65	8.65
February	6.80	5.17	4.89	5.93	7.65	8.65
March	7.75	4.77	4.89	6.14	7.65	8.65
April	7.70	4.53	4.89	6.14	7.65	8.65
May	7.10	4.43	4.89	6.20	7.65	8.65
June	7.10	4.53	4.89	6.63	7.65	8.65
July	7.27	5.14	4.91	6.64	7.65	8.65
August	7.56	5.14	5.11	6.79	7.65	8.65
September	7.54	5.24	6.51	7.33	7.65	8.65
October	6.45	5.40	6.89	7.64	8.36	8.65
November	5.98	5.12	6.89	7.64	8.65	8.65
December	5.36	4.89	6.46	7.65	8.65	*8.67
Average	6.90	4.98	5.51	6.73	7.88	8.65

*Reflects 3% freight tax.

The Iron Age

Lead at New York, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	6.65	3.75	3.00	4.00	3.69	4.60
February	6.85	3.72	3.00	4.00	3.53	4.51
March	7.41	3.15	3.15	4.00	3.58	4.60
April	7.19	3.00	3.27	4.18	3.69	4.60
May	7.00	3.00	3.65	4.14	3.96	4.60
June	7.00	2.99	4.17	3.98	4.02	4.60
July	6.80	2.73	4.46	3.77	4.12	4.60
August	6.75	3.24	4.50	3.75	4.25	4.60
September	6.88	3.47	4.50	3.68	4.41	4.60
October	6.87	3.05	4.32	3.65	4.51	4.63
November	6.29	3.04	4.29	3.57	4.50	5.11
December	6.25	3.00	4.14	3.60	4.50	5.58
Average	6.83	3.18	3.87	3.86	4.06	4.71

	1937	1938	1939	1940	1941	1942
January	6.00	4.87	4.83	5.47	5.50	6.50
February	6.23	4.63	4.80	5.08	5.60	6.50
March	7.19	4.50	4.82	5.19	5.77	6.50
April	6.32	4.50	4.78	5.07	5.85	6.50
May	6.00	4.40	4.75	5.02	5.85	6.50
June	6.00	4.15	4.80	5.00	5.85	6.50
July	6.00	4.88	4.85	5.00	5.85	6.50
August	6.45	4.90	5.04	4.85	5.85	6.50
September	6.40	5.00	5.45	4.93	5.85	6.50
October	5.75	5.10	5.50	5.31	5.85	6.50
November	5.03	5.09	5.50	5.73	5.85	6.50
December	4.87	4.84	5.50	5.50	5.85	6.50
Average	6.02	4.74	5.05	5.18	5.79	6.50

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Air Powered RIVITOR

For aircraft production, Model RP shown, also available in "Twin" types for setting two rivets at the same time.

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STATISTICAL

Straits Tin at New York, Cents a Pound

	1929	1932	1933	1934	1935	1936
January	49.21	21.80	22.70	51.98	50.91	47.23
February	49.39	21.97	23.51	51.78	49.99	47.94
March	48.85	21.81	24.35	53.84	46.88	48.00
April	45.93	19.17	27.16	55.66	50.05	46.97
May	43.88	20.90	35.94	53.57	51.10	46.31
June	44.20	19.58	44.23	51.31	51.08	42.24
July	46.29	20.89	46.28	51.94	52.31	42.96
August	46.60	22.98	44.71	51.99	50.46	42.57
September	45.32	24.76	46.46	51.52	49.05	44.77
October	42.25	23.91	47.95	51.01	51.25	44.95
November	40.18	23.31	53.14	51.24	51.88	51.30
December	39.87	22.70	52.91	50.92	49.77	51.85
Average	45.16	21.98	39.12	52.23	50.39	46.42

	1937	1938	1939	1940	1941	1942
January	50.90	41.54	46.39	46.73	50.16	52.00
February	52.10	41.23	45.64	45.85	51.41	52.00
March	62.74	41.16	46.17	47.07	52.07	52.00
April	59.02	38.41	47.16	46.96	52.03	52.00
May	55.64	36.83	49.00	51.51	52.18	52.00
June	55.88	40.36	48.81	54.64	52.68	52.00
July	59.34	43.38	48.53	51.61	53.41	52.00
August	59.40	43.26	48.80	51.21	52.45	52.00
September	58.64	43.40	Nom.	50.30	52.00	52.00
October	51.52	45.25	55.68	51.50	52.00	52.00
November	43.34	46.29	52.65	50.57	52.00	52.00
December	42.96	46.21	51.40	50.11	52.00	52.00
Average	54.29	42.28	49.11	49.84	52.03	52.00

—The Iron Age—

Magnesium
Cents a Lb., 99.8%, at New York

1929	56	1934	26	1939	27
1930	48	1935	30	1940	27
1931	34	1936	30	1941	27
1932	29	1937	30	1942	22.50
1933	28	1938	30		

—The Iron Age—

Virgin Aluminum, 99% Plus, Delivered Cents a Pound

	1929	1932	1933	1934	1935	1936
January	23.90	23.30	23.30	23.30	20.50	20.50
February	23.90	23.30	23.30	21.65	20.50	20.50
March	23.90	23.30	23.30	21.65	20.50	20.50
April	23.90	23.30	23.30	21.65	20.50	20.50
May	23.90	23.30	23.30	21.65	20.50	20.50
June	23.90	23.30	23.30	21.65	20.50	20.50
July	23.90	23.30	23.30	21.65	20.50	20.50
August	23.90	23.30	23.30	21.65	20.50	20.50
September	23.90	23.30	23.30	21.65	20.50	20.50
October	23.90	23.30	23.30	21.49	20.50	20.50
November	23.90	23.30	23.30	20.50	20.50	20.50
December	23.90	23.30	23.30	20.50	20.50	20.50
Average	23.90	23.30	23.30	21.58	20.50	20.50

	1937	1938	1939	1940	1941	1942
January	20.50	20.00	20.00	20.00	17.00	15.00
February	20.50	20.00	20.00	20.00	17.00	15.00
March	20.00	20.00	20.00	20.00	17.00	15.00
April	20.00	20.00	20.00	20.00	17.00	15.00
May	20.00	20.00	20.00	20.00	17.00	15.00
June	20.00	20.00	20.00	20.00	17.00	15.00
July	20.00	20.00	20.00	20.00	17.00	15.00
August	20.00	20.00	20.00	20.00	17.00	15.00
September	20.00	20.00	20.00	20.00	17.00	15.00
October	20.00	20.00	20.00	20.00	15.00	15.00
November	20.00	20.00	20.00	20.00	15.00	15.00
December	20.00	20.00	20.00	20.00	15.00	15.00
Average	20.08	20.00	20.00	20.00	16.87	15.00

—The Iron Age—

Data for Other Years

Price and production data for years preceding 1929 were published in THE IRON AGE Statistical Supplement, Jan. 4, 1940.

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Over 160 in active operation and on order; get the facts.

The AMSLER–MORTON Company
FULTON BUILDING PITTSBURGH, PA.

Metallurgy at War

(CONTINUED FROM PAGE 125)

of microscopic evidence of tin was characteristic of all the series investigated. The higher tin steels were usually finer grained than the low tin steels, but the pearlite and ferrite or tempered martensite were unaltered.

In a report of influence of tin on alloy steels by Bolsover and Barraclough (British Iron and Steel Institute paper, reported in THE IRON AGE, Oct. 22, 1942), various types of Mn-Mo; Ni-Cr steels were investigated, with a tin content running from 0.1 to 0.5 per cent. The early results stirred interest in the influence of molybdenum, if present, on a high tin content. On all hardened and tempered steels examined, the influence of tin at even 0.1 per cent was noticeable on notched-bar tests.

In the carbon steel which was used for a comparison basis, the effect was not so noticeable in the oil quenched after tempering condition as in the normalized state. On alloy steels, the effect of tin additions appears to be counteracted by the addition of molybdenum. However, higher phosphorous steels, generally, give lower results than low phosphorous steels, but it was suspected that this was more a reflection of a lowering of the impact value owing to the phosphorous content rather than to any increasing effect of tin on the high phosphorous steel as compared to low phosphorous steel.

The effect of tin on nitriding steels appears to be counterbalanced to some extent by molybdenum additions, but the lowering of the impact value after nitriding in the presence of tin is marked. The 4.25 per cent Ni-Cr case hardened steel suffers only a slight decrease of impact value up to 0.15 per cent tin, but with higher contents, the values fall very sharply.

Lithium and Indium

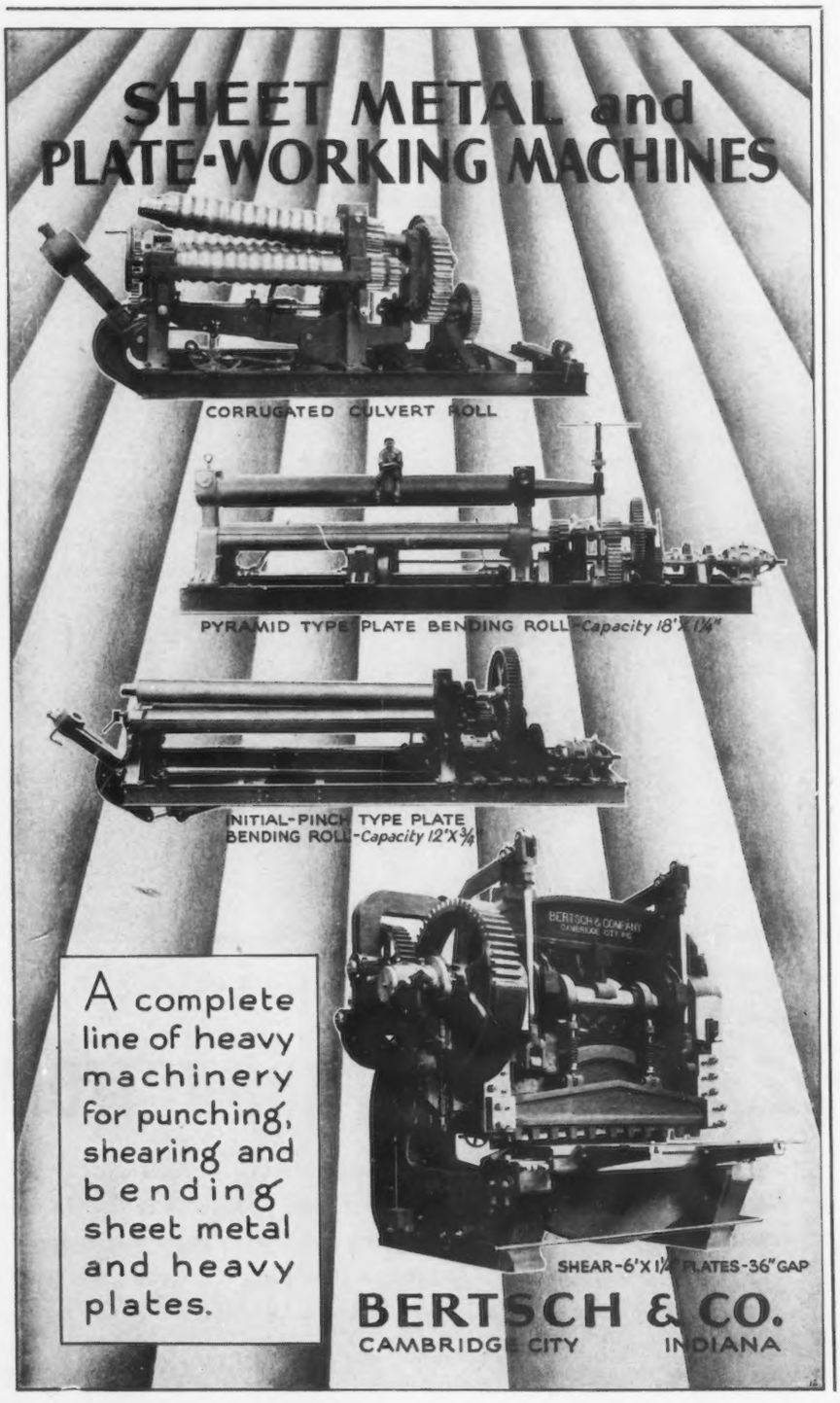
Under the stress of material shortages there has been a flurry of interest in a number of metals which, for economic or metallurgical reasons, have not received much attention in the past. Two such materials are lithium and indium.

Hensel, Larsen and Swazy reported (*Metals & Alloys*, June, 1942) a rather interesting use for lithium in silver solder for brazing tungsten-copper electrical contacts.

A number of brazing tests were run with silver alloys containing 0 to 0.26 per cent lithium. As a result of these tests it was concluded that a lithium-bearing silver solder is superior to other general types, so far as fluidity, wetting, tensile and cross breaking strength are concerned, particularly on large brazed sections.

This superiority was evident not only in brazing copper to tungsten-copper, but also in brazing certain ferrous and non-ferrous alloys containing oxidizable ingredients such as chromium, molybdenum, or tungsten.

The authors expressed the belief that eutectic silver-copper compositions containing nickel and lithium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have definite advantages for brazing. They also reported that a silver solder containing 60 per cent Ag, 20 per cent Cu, 15 per cent Zn, 4.9 Ni and 0.1 Li is extremely promising as a high strength, high fluidity brazing medium.

There was little done during the year on original research on indium, but a summary of the general position of this material was made by Ludwick (*Steel*, Nov. 9, 1942) (See, also, THE IRON AGE, Dec. 19, 1940).

Indium was described as one of the few materials not restricted by wartime regulations. This material, the 49th element in the periodic table, is described broadly as being to non-ferrous metals what chromium is to ferrous materials. It provides resistance to wear and corrosion, inhibits fatigue and friction and imparts a lustrous, continuous finish.

Currently indium is obtained in commercial quantities by recovery from scoria of zinc refining. However, there are other rich sources which can be tapped to meet demand if necessary.

The best known use of indium now is in bearings of lead, cadmium, silver or copper. Such bearings have found successful use in aviation type bearings, for heavy duty and for diesel marine engines.

Two new and promising applications are for brazing and soldering alloys where a small amount of indium apparently improves the soundness of the braze. Indium itself has good wetting properties on steel.

Indium is a member of the aluminum group, as regards its properties. It has a melting point of 311 deg. F. and boils at 2642 deg. F. Specific gravity is 7.31, atomic weight is 114.76 and hardness is 1 Brinell.

While indium alloys well with non-ferrous metals, the chief interest is in its use with silver. A small portion of indium, added to silver improves resistance and wearing qualities of surfaces of such alloys. For example, 1 per cent of indium added to cast silver increases hardness from 46 to 92 Rockwell H.

Addition of 1 per cent indium to lead increases tensile strength from 1600 lb. per sq. in. to between 2400 and 3000 lb. per sq. in. Alloys of lead and indium up to 6 per cent indium show regular solid solutions, as the addition of indium affects the crystal size from the start. Dendrides begin to form at 8 per cent.

Indium plates readily and is easy to handle. The most widely used plating process for indium is the patented cyanide bath followed by heat treatment.

Light Metal Protection

The unending battle between the United Nations and the Axis for air superiority, and the vital role that reliability of performance in a plane plays in achieving such superiority, has intensified study of protective coatings for the light metals.

A European view on corrosion protection of Mn-Cu-Al alloys by cladding with aluminum containing about 0.5 per cent calcium was discussed in *Z. f. Metallkunde*. Perfect adhesion of such a coating was obtained with normal cladding procedure, it was reported, but, unexpectedly, microscopic examination

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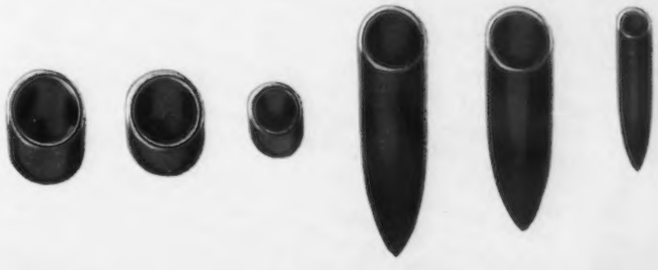
Superior engineers originated and developed SuVeneer clad metal. If you are working on "tomorrow," Superior will be glad to cooperate—glad to show you how SuVeneer's proved advantages can lower costs and increase the efficiency of your projected products!



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of the coating showed it to possess a heterogeneous structure and, as the amount of calcium added was below the limit of solid solubility at normal temperature, it was surmised that the disperse plan consisted probably of calcium silicide.

Corrosion tests of clad aluminum in salt spray gave satisfactory results, and heat treatment of the clad sheet resulted in improved corrosion resistance. This was not the case, however, with duralumin, due probably to the formation of a protective layer of calcium hydroxide.

With this in mind, it was suggested that the calcium content of the clad layer be raised to the maximum limit of solid solubility at room temperature in order to promote the thickness and continuity of the calcium hydroxide film.

It appears that substantial progress is being made toward the development of a technique for electrodeposition upon magnesium. Two important obstacles—that of a treatment designed to prepare the surface for reception of the electroplated coating and the use of a plating solution containing the heavy metal in the form of a complex soluble salt which gives a minimum of free heavy ions capable of plating out on the magnesium—have been overcome in a process developed by Dow Chemical Co. (Electrochemical Society paper, April, 1942).

Nickel borofluoride, soluble in water, was used for the salts in early work. Some adhesion was obtained on surfaces treated in nitric acid-chrome acid "chrome pickle." It was, however, not good enough for practical purposes and also required considerable etching of the surface, which resulted in rough deposits. An attempt was then made to remove the chromate film by dipping in hydrofluoric acid. In this way the building up of the chromium in the nickel plating bath was prevented, and much better adhesion was obtained with less severe etching. Subsequent investigations showed that the addition of nitric acid to the hydrofluoric acid used to remove the chromate film gave exceptionally good adhesion between nickel and magnesium alloys.

In plating, the parts are buffed and the buffing compound removed with a solvent. The magnesium is then subjected to cathodic cleaning. The bath solution is made up of sodium carbonate, trisodium phosphate; sodium hydroxide; sodium metasilicate; and a small amount of sodium lauryl-sulphonate. The bath is used at a temperature of 70 to 90 deg. C. (158 to 194 deg. F.) and treatment is continued for 1 min. with a current density of 50 amp. per sq. ft.

The parts are washed with hot water and cold water and then chrome pickled. This chrome pickle bath is made with chromic anhydride, CP; nitric acid, CP; and sulphuric acid, CP; This solution is used at room temperature with a five sec. immersion, followed by a cold washing. For the modifying acid dip, a solution is used containing hydrofluoric acid (52 per cent HF) and nitric acid, CP, with a 2 to 5 min. immersion. After a cold washing, parts are ready for plating.

As a result of numerous investigations with various solutions and concentrations and densities, a

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THAT TOGO BUILT

THIS IS THE **SHELL**

THAT WRECKED THE PLANE
THAT TOGO BUILT

THIS IS THE **BLANK**

THAT MADE THE SHELL
THAT WRECKED THE PLANE
THAT TOGO BUILT

THIS IS THE **UPSETTER**

ALWAYS READY
THAT SHAPED THE BLANK
THAT MADE THE SHELL
THAT WRECKED THE PLANE
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THIS IS THE **FORGEMAN**

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ALWAYS READY
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nickel plating bath was developed which gave good results. This bath was made up with nickel sulphate, boric acid, ammonium fluoridel hydrofluoric acid (to reduce pH to 5.5) and Duponol ME. The ideal temperature was 40 deg. C. (104 deg. F.) with a current density of 10 to 30 amp. per sq. ft.

The Duponol ME is a wetting agent developed by du Pont which was found to be one of the few wetting agents that would remain stable in the nickel borofluoride bath.

The nickel deposits obtained were eminently satisfactory from both the point of appearance and adhesion. The question of the corrosion resistance of such parts depends in a large measure on the porosity of the nickel plate. With a porous coating, the casting is subject to corrosion in aqueous solutions. Die castings plated with 0.001 in. of nickel pitted in only a few hours in the salt spray test. Triple plates of nickel, cadmium and nickel deposits on die castings with a total coating thickness of 0.001 to 0.0015 in., with the cadmium and final nickel deposit buffed to reduce porosity, have withstood 20 hr. of salt spray before pitting began.

On the other hand, in indoor atmospheres die castings plated with nickel and chromium have been exposed to air for more than two years in a laboratory and have remained in perfect condition.

An interesting viewpoint on chemical finishes versus anodic treatment for aluminum alloys, together with test results showing the corrosion resistance of chemical coatings on various types of aluminum alloys was reported early in the year. (*Light Metals*, February, 1942). It was pointed out that while anodic oxidation was by far the most important process for imparting high corrosion resistance to aluminum and aluminum base alloys, there are certain considerations, especially in war time, which make it worth while to consider the chemical processes.

One such consideration is that chemical processes do not require generating equipment and in most cases tanks already in the plant can be utilized. In addition, the chemical processes are better adapted to handle the wide variety of shapes, sizes and weights which must be treated in the average plant.

The simplest chemical treatment is of course, the process using potassium chromate or sodium as the effective chemical. A typical formula for this process is 4 per cent by weight of potassium chromate (6 to 7 oz. per gal.) with treatment taking place for 30 min. at the boiling point. The inclusion of sodium carbonate in the mixture improves the degree of corrosion resistance and permits shorter immersion periods.

Potassium chromate appears to produce better results than the corresponding sodium salt and one process has been established using the following mixture: anhydrous sodium carbonate, 8 oz.; potassium chromate, 3 oz.; distilled water, 1 gal.; operating temperature, gently boiling; immersion period 10 to 15 min.

It is important to remove all oil, grease, and other lubricants, dirt, finger marks, etc. Generally, tri-

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THERM-O-FLAKE Coating works with surprising ease. Trowelled or gunned—it spreads unusually fast and is economical because of its greater coverage.

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THESE are challenging days in which to live and work—and America has met the challenge. Week by week, the people of this country are proving that they can make sacrifices and ignore discomforts. And industry has met the challenge by pooling its knowledge and resources, developing new techniques and materials, and creating a vast new reservoir of supply.

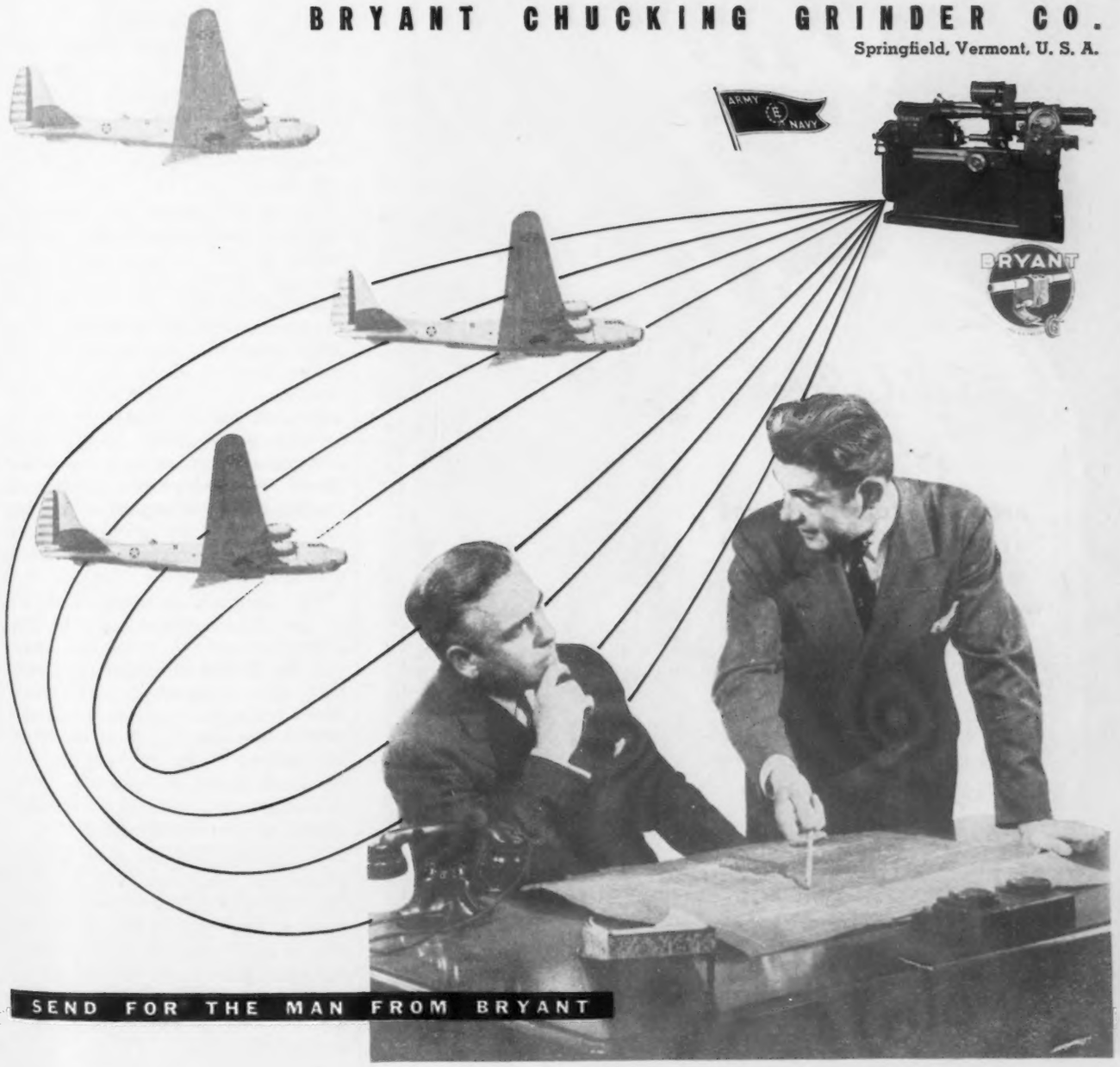
The result of all this is a great new market of the future: A growing demand for millions of war-restricted articles—new, improved products for post-war competition—a backlog of savings created by war bonds and curtailed buying. . . . The result, say many of America's foremost analysts, is *post-war prosperity!*

If you are to be prepared for a quick transition from armament to peacetime business, *now* is the time to study your tooling problems—and in this we can help you. For Bryant engineers are among the foremost authorities in the specialized field of internal grinding . . . and today, with their major war production problems solved, they are once more ready to help you.

Write now and give them full information on your internal grinding problems.

BRYANT CHUCKING GRINDER CO.

Springfield, Vermont, U. S. A.



SEND FOR THE MAN FROM BRYANT

chlorethylene vapor liquid - vapor treatment is sufficient. A mild alkaline cleansing is desirable if soluble oil or soap press greases are involved.

It is important that effective means be provided for exhausting fumes from the chromate bath. Exhauster slots should be placed at least along both edges in tanks more than 18 in. wide, while for larger tanks they should be installed on all four sides.

The appearance given to parts treated in a chromate bath is related largely to the analysis of the metal, as well as to the condition of the surface. Commercially pure aluminum gives a lustrous finish, slightly gray in color. The 7 per cent magnesium alloy shows an increase in luster and a tendency to iridescence. The 2 per cent magnesium alloy gives a lustrous finish, with a dark gray color. Duralumin tended to be matte and to show a mother of pearl effect or to darken slightly. The 10 per cent silicon alloys became a dark gray, dull, in some cases having a loose superficial finish.

Summing up, it was stated that the chromate treatment is rapid and flexible. The pylumin type of process is foolproof and consistent and admirably suited to the finishing shop treating a variety of work. On aluminum, aluminum-magnesium and aluminum manganese alloys it is effective and attractive. On more complex and less corrosion resistant alloys, it is still effective.

Extensive tables in this report gave the results of various alloys which were treated in a chromate bath and then subjected to a standard salt spray test for varying hours. The results differed with the type of alloy being treated, but generally indicated that an effective protection was available. For example, aluminum sheet of various tempers, treated by this process, showed no effect after 56 hr. in the salt spray test.

A comparatively new plating technique, recommended largely for corrosion resistance and as a lubricant for wire drawing, is sulfamate lead plating which was described at the annual meeting of the American Electroplaters' Society by E. W. Schweikher of E. I. du Pont de Nemours Co. (reprinted in THE IRON AGE, July 2, 1942). The basis of this new process is the lead sulfamate solution, with addition agents which together produce a ductile, pore-free deposit. The solution is made up with prepared plating salts and two special addition agents.

The composition of the bath, in oz. per gal., is: Lead salts, 40 oz.; addition agent No. 1, 1.3 oz.; addition No. 2, 0.04 oz. Addition agent No. 1 is a stable organic compound whose purpose is to provide a dense, smooth, deposit free from trees. It is most important for plating flat surfaces. Addition agent No. 2 is important for plating irregular shapes or barrel plating.

The anode- cathode ratio in this process is approximately 1 to 1. The throwing power of the solution is zero, but the covering power is good if addition agent No. 2 is used. Adhesion directly to steel is not of the best, but with good cleaning and a severe acid etch, it was described as fair.

Air Warcraft Comes of Age

(CONTINUED FROM PAGE 117)

by any of the fighting nations a correct relationship between the powers of present-day weapons. A super-fighting weapon has never won any war, and it will not win this one. What is needed most is the ability and the carrying out of this ability by one side or the other to upset the enemy's tactics and thus enable the decisive use of the weapons on hand. To do this, complete coordination of weapons, with each in its proper relative position, must be found. The airplane today is without a doubt the best weapon in the war because of its accuracy, range, and capacity to carry the war not through but over the battlefield, beside it, behind it, and to it, but it too has its limitations.

Arguments can be substantiated on both sides when it is suggested that any plane today is the best of its type in the world. However, from a general standpoint, there is at present no plane of any given type that has a sufficiently decisive advantage over other planes of its type to be called the best in the world. The British "Spitfire," a truly marvelous ship, has been classed by such experts as Alexander de Seversky as the world's best fighter craft in spite of the fact that his own company is building the "white hope" of the U. S. Army. One Naval expert classes the Grumman "Wildcat" as the No. 1 fighter. The British claim that the B-19 "Flying Fortress" is not a really first class heavy bomber when compared with the Stirling, Halifax, and Lancaster, but stories like that which came from London on Nov. 19 where a single "Flying Fortress" fought off a formation of 30 Focke-Wulf-190's — Germany's pride and joy of the fighter ship class—and returned to its base have never been matched by any of the British ships. On the other hand, these fine British ships have been highly successful on sweeps over enemy held territory at times that would most assuredly have been fatal to the "Flying Fortress."

Likewise, there have been persistent noises out of the Pacific that the Jap "Zero" surpasses any American fighter ship. The "Zero" is a good ship — light, maneuver-

(CONTINUED ON PAGE 262)

OUR FIGHTING FORCES' JOINT RECOGNITION OF A JOB WELL DONE!
"Well Done" jobs have for many years been a commendable characteristic of WYCKOFF peacetime steel production. In today's fight for freedom, the distinguished joint awards—the Army-Navy "E" and *added* STAR—honors WYCKOFF Production Soldiers as true fighting partners—shoulder to shoulder—eye to eye—purpose to purpose!
Our steadfast resolve—to continually improve our war assistance production—is daily evidenced by WYCKOFF'S "carry-on" spirit and increasing flow of WYCKOFF steel for *victory*.
E
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1. Bureau of Ordnance Flag and Navy "E"
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Manufacturers of Carbon and Alloy Steels . . . Turned and Polished Shafting . . . Turned and Ground Shafting . . . Wide Flats up to 12"x 2"

Welding Given War Impetus

(CONTINUED FROM PAGE 135)

away work. There is still a lot of hand welding required for finishing up.

It should be pointed out that none of the wire used is coated and there have been no shortages of steel, either carbon or stainless, reported for this class of work. The wire is usually charged into the machines in 25-lb. coils and stub loss is negligible.

Constant Potential D.C. Sets

Although single operator sets still predominate in the shipyards, an increasing number of constant potential, multiple operator d.c. machines have been installed during the past year. These sets range in capacity from 1500 to 3000 amp. Many jobs in shipyards, such as tack welding, have a low duty factor (around 25 per cent), and on this class of work 32 operators normally drawing 150 amp. each can work off one 1500-amp. machine. Most of these big machines are driven by synchronous motors and the inherent high power factor and efficiency of these units more than offsets the losses at the individual resistor stations, particularly since these losses are effective only during actual welding.

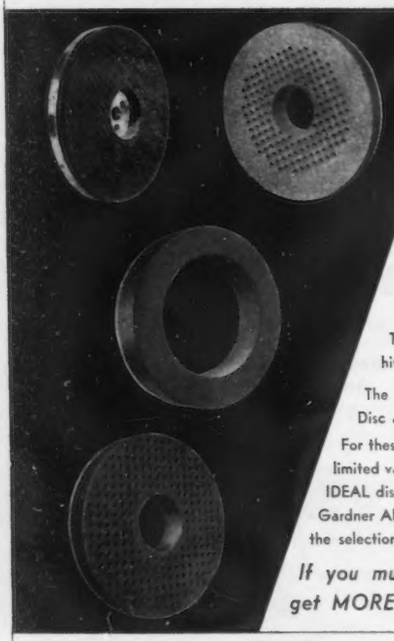
Single operator sets have been mounted in pairs or in a cradle of four, to facilitate moving the units about the hull as the work proceeds.

Welding Aircraft Tubing

Introduction of crater eliminators has done much to extend the application of arc welding to aircraft tubing like X4130 and the substitute steel, NE 8630. The tendency to form a crater when the electrode is withdrawn from the work is likely to leave a hole in thin gage material. Crater eliminators avoid this by tapering off the welding current and voltage at the end of the bead. In one type of equipment, which is semi-automatic, the field rheostat is motor operated by a push button mounted on the handle of the electrode holder. Releasing the button reverses the motor and restores the original open circuit voltage. In another foot operated control, rate of current decay is at the control of the operator and a field forcing device is incorporated in the foot switch to provide higher current for a "hot" start.

Low amperage sets have been brought out for aircraft tubing applications. These include types using electronic and copper oxide rectifiers operating from a three-phase a.c. supply. Motor-generator types have been designed with high instantaneous recovery of voltage that helps the operator strike the arc with ease on thin metals having a bright, polished surface. Another type has the generator windings modified for constant potential operation and is used in connection with two to four resistor stations, just as in the case of the much larger constant potential sets used in shipyards. Each operator can regu-

Make your Disc Grinders *produce more*



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IN THESE days, when every ounce of productive capacity is needed more than ever before, new equipment is not the ONLY solution.

The Production Official who strains his present facilities to the utmost — who gets every last bit of efficiency out of an old machine or tool — is a valued contributor to the War Effort, and to the output of his company, as well.

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The use of modern, heavy-duty Gardner WIRE-LOKT Abrasive Disc and Wheels, will guarantee that result.

For these long-lived, free-cutting abrasives, available in an almost unlimited variety of grades, grains and bonds, permit the selection of the IDEAL disc for YOUR work, whatever it may be. And an experienced Gardner Abrasive Service Man is conveniently located to help you make the selection, and to insure prompt service at all times.

If you must wait many months for NEW Grinders, get MORE out of your present machines — TODAY!

GARDNER WIRE-LOKT ABRASIVE DISCS and WHEELS *speed production* on ALL Disc Grinders

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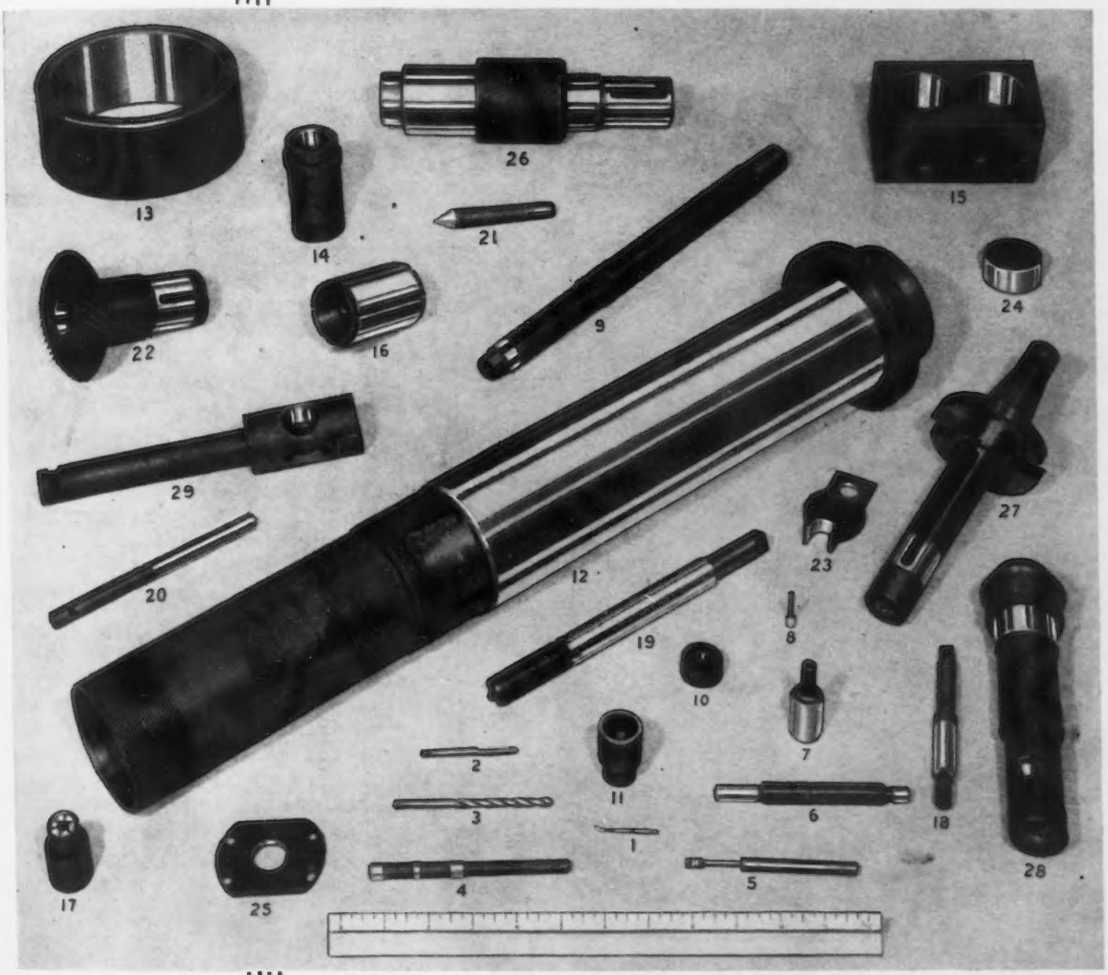

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Send us a small part to Micro-Plate . . . if you're not entirely satisfied, return our invoice.

INDUSTRIAL CHROMIUM CORP.

HOLYOKE MASSACHUSETTS

late his own current and weld without affecting the others in any way. A current fading device for crater elimination is included, with push button control at the electrode holder.

Arc Welding Magnesium

During the past year, a practical method of arc welding magnesium alloys was disclosed. It involves the use of a tungsten electrode and a protective atmosphere of helium. The arc is struck between a tungsten electrode and the base metal rather than between two tungsten electrodes as in the atomic hydrogen process and to that extent more nearly resembles the carbon arc process. In all three processes, the welding rod must be fed in separately. Helium has over five times the specific heat of air and acts as a coolant, keeping the weld cooler and giving better fusion and penetration. The electrode is held very close to the weld so as to get the best shielding effect of the helium gas. With automatic equipment on single pass welds, distances of 1/16 in. may easily be used.

The work is done with a conventional d.c. welder, using about 150 amp. and reversed polarity. The tungsten electrode protrudes from a hollow cup which is insulated from the electrode by a refractory material. Fairly pure helium is required. Such impurities as carbon dioxide, hydrogen, nitrogen and hydrocarbons cause pronounced defects such as porosity and inclusions. The most expensive item in this new method is the cost of the helium which runs around 8.5c. per cu. ft. in 220 cu. ft. cylinders. In carload lots, however, the cost is near 2c. per cu. ft.

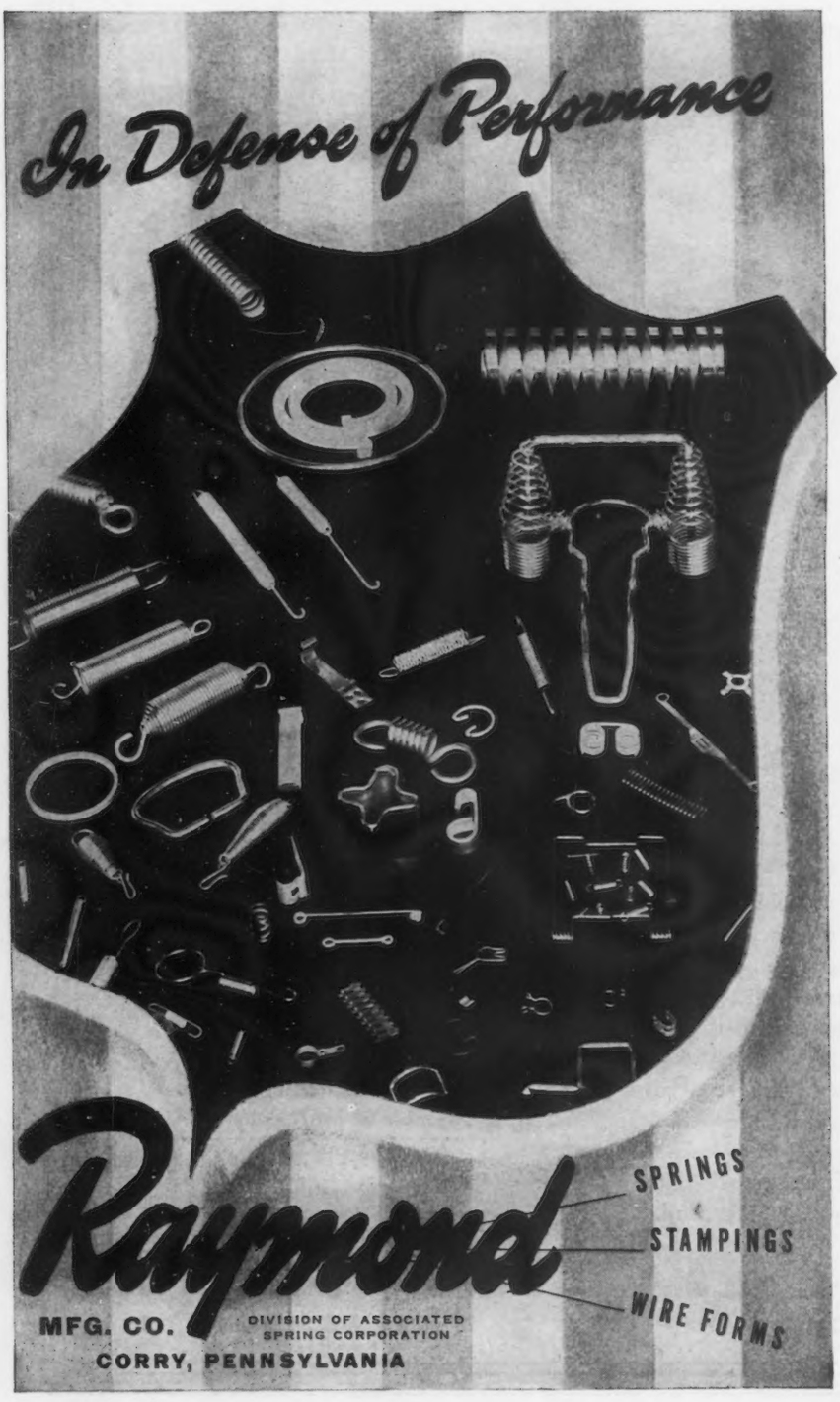
Contrary to popular belief, in welding magnesium, the metal surrounding the weld should be kept cold, and a stream of water is usually played on the back of the metal, particularly for the cast grades.

The fabrication of strong, light magnesium alloys by this new Heliarc method has opened up possibilities of application that were not considered even a year ago. For one thing, now that this process is available, advantage can be taken of the much higher compressive strength of rolled or extruded shapes as compared with castings which were frequently used only because of fabrication difficulties with rolled materials. The use of automatic welding holds considerable promise.

One of the difficulties presented in welding magnesium is the hot shortness of some of the alloys. Best results on these materials are obtained when relatively high speeds of deposition are used. Under these conditions there is less heat flow and annealing of the adjacent area. The hot metal is brought through the hot-short range so rapidly that the danger of cracks is largely eliminated.

Roll Welding of Aluminum

During the year the application of condenser discharge type resistance welding of aluminum alloy sheets was extended to roll spot welders. The rolls are rotated either continuously or intermittently. In the latter case, the



Announcing

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From the largest producer of spot-welding gun equipment you can now also obtain the most modern of seam welders. The complete line comprises 126 models including circular (transverse), straight (longitudinal) and Universal (illustrated) Seam Welders.

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PROGRESSIVE WELDER CO.

SEAM, PROJECTION & BUTT . . . *Electric Welding Equipment* . . . PORTABLE GUN & PEDESTAL

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machine functions much as an automatic spot welder. Elaborate transfer tables of large size are used to feed the sheet assemblies through the rolls by power. Micarta tops prevent injury to the sheets. Speeds up to 300 precision-spaced spots per minute have been obtained. By comparison, 1000 spot welds per hr. is considered good practice with single electrode machines operating on the stored energy principle. In general, spot welding of highly stressed structures is still waging an uphill fight against riveting of aluminum.

D.C. Seam Welding

Another marked advance in resistance welding has been the development of high speed seam welders operating on direct current. Copper rectifiers are employed, supplied from a three-phase a.c. power source. This equipment enables thin gage steel to be joined with overlapping spot welds at much higher speed than can be accomplished with conventional single-phase a.c. welding transformers because with the latter apparatus the weld time cycle cannot be less than ½ cycle per spot. With a minimum of 12 spots per inch in 0.024 in. gage material, this limits the speed to 50 ft. per min. Higher frequencies than 60 cycles have their limitations due to the increase in the reactance of the copper bus sections in the throat and in the work itself. Speeds up to 140 ft. per min. are possible with d.c. equipment, making the process competitive with mechanically formed joints that are soldered.

The copper oxide rectifiers can be hooked up so as to get full wave rectification of the three-phase current and thus provide uniform welds. Dry disk rectifiers of this type have inherent low voltage and high current characteristics best suited for this service. Welding potential is only 2-3 volts, ruling out mercury vapor tube rectifiers which have a normal voltage drop of 15 volts across the tubes themselves.

Spot Welding Hardenable Steels

Considerable research was carried on in the past year on techniques for spot welding hardenable steels. Extremely brittle welds are produced in SAE x4130 steel sheets, 0.040 in. thick, for example, when welded by conventional single pulse methods. Experiments showed that this steel could be tempered by a brief post heat treatment in the welding machine after allowing the weld nugget to cool just to the point where martensite is formed. This drawing allows precipitation of the carbides held in super-saturated solution in the martensite, thus producing a strong, ductile weld. The investigation showed that the best cycle for SAE X4130 was 6 cycles on, 18 off and 6 cycles for post heat treatment. The optimum heat-treat current is about 90 per cent of the weld current.

The mechanized oxyacetylene welding of light gage materials is being used for such articles as naval shell cases and incendiary bomb containers. Hand welding is used for the short seams on final assembly.

(CONTINUED ON PAGE 230)

How to . . .
SAVE MAN-HOURS

★ Logan Roller Conveyors, Ball Plates and Belt Conveyors speed up packing in a large manufacturer's shipping department.

IN hundreds of key plants Logan Conveyors are playing an important part in keeping production man-hours at a minimum while output is increasing. Perhaps there are handling operations in your war work which can be conveyorized to release precious manpower for more productive tasks. Logan conveyors provide an uninterrupted flow of work from one operation to the next, eliminating waste motion and stepping up output. If you have a handling operation on which you would like to conserve manpower, why not call in your nearest Logan engineer?...or write Logan, 545 Cabel St., Louisville, Ky.

Logan Conveyors
PUT FLOW INTO PRODUCTION

FEATURE CONTINUATIONS

(CONTINUED FROM PAGE 292)

about 60,000,000 oz.; imports were about 100,000,000 oz., mostly from Latin America and Canada. The Treasury holds over three billion oz. (125,000 tons) of which 2,000,000 oz. in monetized or pledged and 1,350,000,000 is unpledged.

Up to April, supplies of foreign silver were adequate for both essential and non-essential uses. Then rising war production and restrictions on tin, copper, nickel and chromium began to pinch, and in May the Treasury, after considerable backing and filling, agreed to lend its unpledged silver to war industry to replace copper bus bars, a non-consumptive use.

Up to September, no newly mined domestic silver was finding its way into industrial use, though finally the Treasury released 4,900,000 oz. of "silver ordinary' for consumptive purposes. Silver ordinary is random silver: scraps left after coinage, silver that came to the Treasury as a by-product of gold, etc. Under the strange rules of this game, the Treasury can sell silver ordinary—which is really no more ordinary than the other silver—at 45c. an oz., but there is very little of it; no more than 4,900,000 oz.

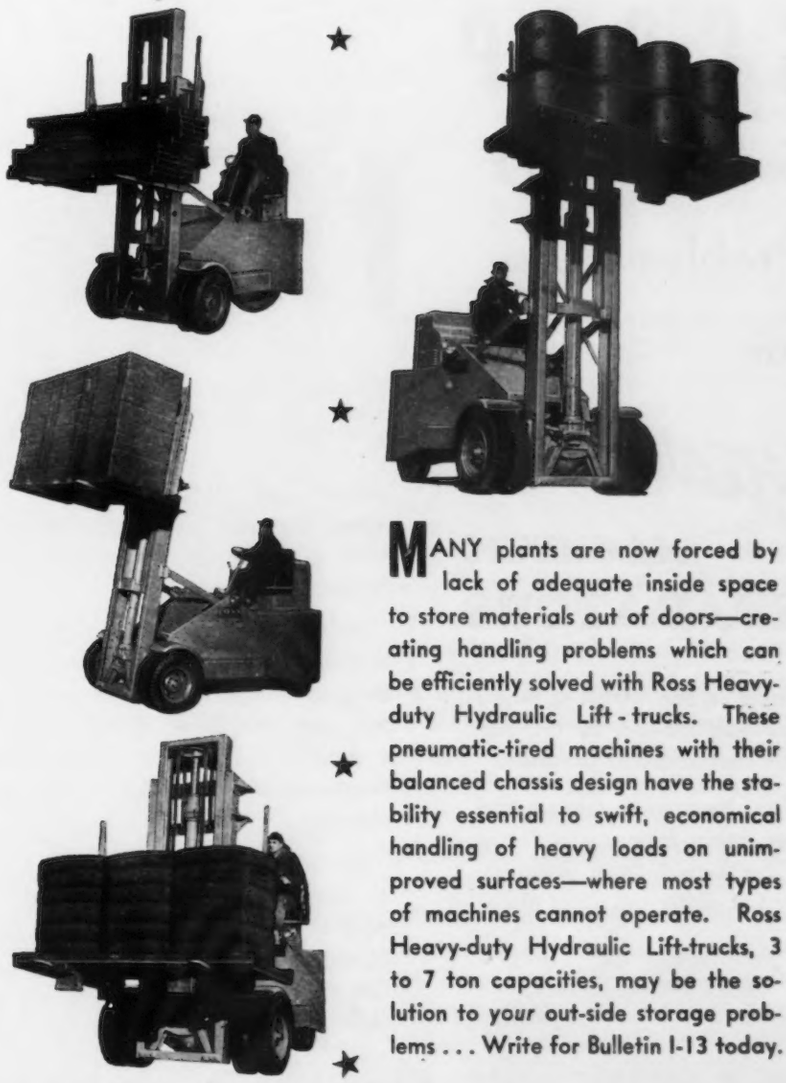
On Sept. 1 the import price was raised from 35⅜c. to 45c., partly to permit Mexico to levy a 7c. emergency tax.

Under the silver purchase act, the Treasury's other silver must be sold at $1.29 an oz.—that portion which can be sold at all. For months a bill, killed by filibuster in December, was before Congress to consider the bus bars and magnetic windings as "pledged" silver backing for silver certificates, and to consider the other Treasury silver in the "free" category for consumptive use, and to reduce its price to 50c. an oz.

Gold, of course, can be put to many of the same industrial uses as silver. The country has about half a billion oz. of gold in another hole, at Fort Knox.

o o o

Where "All Outdoors" is Your Warehouse!



MANY plants are now forced by lack of adequate inside space to store materials out of doors—creating handling problems which can be efficiently solved with Ross Heavy-duty Hydraulic Lift-trucks. These pneumatic-tired machines with their balanced chassis design have the stability essential to swift, economical handling of heavy loads on unimproved surfaces—where most types of machines cannot operate. Ross Heavy-duty Hydraulic Lift-trucks, 3 to 7 ton capacities, may be the solution to *your* out-side storage problems . . . Write for Bulletin I-13 today.

ROSS

HEAVY DUTY MATERIALS-HANDLING EQUIPMENT

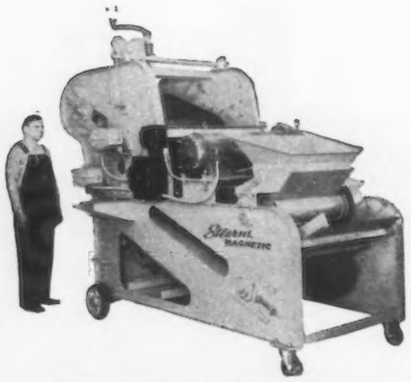
BENTON HARBOR • MICHIGAN

(CONTINUED FROM PAGE 228)

Development work carried on over a considerable period of time proved the feasibility of the mechanized oxyacetylene welding of aluminum. This procedure is being used in the production of aluminum shell cases and auxiliary gas tanks. Bronze-welding or silver-soldering is being used for assembly work on chemical and incendiary bombs, shell nose sealing, and box cover fasteners. Heating is done by hand blowpipes or completely automatic arrangements with special heating-head setups.

Hot-spinning is being done on aerial bombs with supplementary oxyacetylene heat applied during the spinning operation, using heads specifically designed for this purpose. The spinning of end closures on primer and burster tubes is accomplished entirely with oxyacetylene flames as a source of heat.

SCRAP
SALVAGE
Problems Easy
for
Stearns
MAGNETIC
SEPARATORS



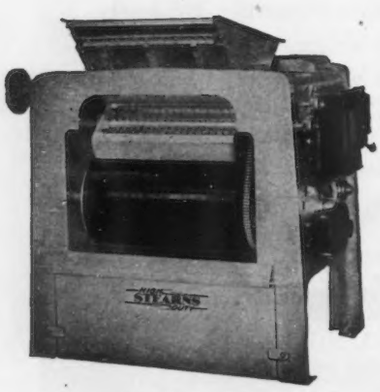
Stearns Magnetic Double Pulley Separator for large capacities. Write for Bulletin 302.

"Clean" scrap metal is being most emphasized in the nation's conservation program.

Your bronze, aluminum and other secondary metals can be reclaimed from borings, turnings, chips and other metal refuse most efficiently, economically and automatically with these Stearns Magnetic Separators.

With improved design through better engineering, Stearns Magnetic equipment will pay for itself quickly—a definitely profitable investment—an aid to better metal salvage.

No doubt you are interested in increasing the value of your scrap metal. Investigate Stearns Magnetic methods. Ask for our suggestions. No obligation.



Stearns Magnetic Drum Type "L" Separator for medium capacities. Bulletin 46.

STEARNS MAGNETIC MANUFACTURING CO.
635 E. 28th St. Milwaukee, Wis.
CLUTCHES—PULLEYS—DRUMS—MAGNETS

The glare problem in welding aluminum with hydrogen torches was solved by Dr. R. C. Burt of Lockheed Aircraft Corp. in cooperation with the Corning Glass Works. The glare is caused by the low temperature at which aluminum melts, the high temperature of the hydrogen torch and the large amount of flux required in this type of welding. Through a series of experiments a combination of light fillers was found that not only filtered out the undesirable rays, but passed sufficient light of other wave lengths to give good visibility of the molten weld puddle. The improved lenses allow a small cone of flame to be seen at the burner tip.

Incidentally, a number of improvements have been made in lenses for both gas welding and arc welding. One of the new lenses used what used to be called "speakeasy" glass, with a light coating of silver on one side which reflects the infra-red rays. The glass takes out the ultra-violet.

Oxyacetylene Cutting

The expanding production of war materials and transportation equipment has increased the use of oxyacetylene cutting. In many instances considerable reduction in machining time has been obtained through gas shape-cutting, thereby increasing the production rate. Steel plates for fabricated structures can be rapidly cut to size, and where required the edges simultaneously can be beveled to the shapes used in welding the assembled structure.

Special cutting machines have been developed to handle the large plate sections used in ship construction. By the use of improved cutting technique it has been possible to double the speeds previously attained. New ways of mounting plate minimize inaccuracies due to plate distortion. Oxyacetylene cutting continues to grow with the increase in shipbuilding because of its part in forming the plate-edge profile used in welding.

Oxyacetylene cutting, used in place of shears, has made it possible for steel mills to maintain rolling schedules when breakdown of mechanical severing apparatus threatened mill shutdown. Similarly, bottlenecks have been eliminated in mills rolling material exceeding their original shear

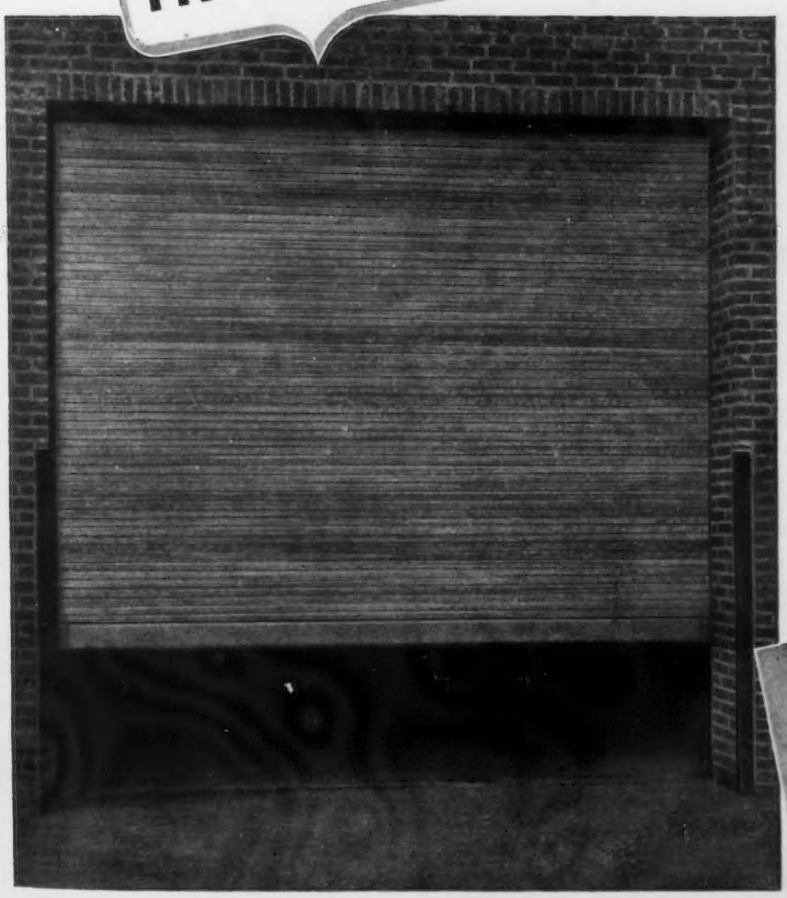
Kinnear *Wood* Rolling Doors

PROVED . . . and ready for WARTIME EFFICIENCY with SAVINGS IN STEEL!

Kinnear Wood Rolling Doors have been widely used for numerous special door requirements for many years. And now they are meeting today's demand for time-and-space-saving doors that minimize the use of critical materials.

They feature the efficient coiling upward action perfected in the famous interlocking steel slat door which Kinnear *originated* nearly half a century ago!

Constructed of inter-lapped wood slats jointed with metal cables or tapes, these sturdy Wood Rolling Doors travel upward in special jamb guides and coil above the opening. As convenient in action as a window shade, they open out of the way and out of reach of damage, requiring no usable floor, wall, or ceiling space for either storage or operation.



Their rugged, closely-assembled wood-slat curtain blocks out wind and weather, and affords a remarkably high degree of protection against intruders and saboteurs. Only carefully selected, specially treated woods are used, assuring maximum wear and resistance to the elements at lowest possible maintenance costs.

To meet all door needs in face of wartime contingencies *without* sacrificing performance and service, install Kinnear Wood Rolling Doors.

Kinnear Wood Rolling Doors are available in any size, for installation in old or new buildings. Motor, manual, or mechanical operation.

***Write Today* FOR BULLETIN 37**

Gives complete specifications and shows how the wood slat curtain is assembled for strength, weather protection and smooth coiling action.

THE KINNEAR MFG. CO.
1760-80 Fields Ave.
Columbus, Ohio

SAVING WAYS IN DOORWAYS

KINNEAR ROLLING DOORS

capacity. Increased cutting speeds have been attained through the use of improved technique on hot steel plate.

With the increased production in foundries of heavy industry, improved equipment and methods for oxyacetylene cutting have been developed to remove risers and hot top sections from large castings.

Nozzle designs have been revised to give longer operating life, and methods of repairing the nozzles have been promoted.

With the emphasis on speed as well as quality, the spread of the use of the oxyacetylene process for flame-treating ordnance materials has been rapid in the past year. Materials being flame-hardened in increasing quantities include many marine parts, as well as tank and combat-car items. Turret rings, tank sprockets, bogie wheel rims, track-shoe grousers, gun mounts and a wide variety of minor mechanical components are being flame-hardened in routine practice.

Considerable expansion in the patterned flame type of hardening has taken place in the last year. This type of flame-hardening uses a pattern of many small oxyacetylene flames distributed in such a manner as to heat a desired surface to a required depth without relative movement between flames and workpiece. In this type of hardening, case depths up to ¼ in. deep are produced, with a treating cycle of approximately ½ min.

Use of oxyacetylene flames to soften the hardened zone along the flame-cut edges of certain air-hardening high carbon or alloy steels has expanded the field of flame-cutting to materials previously considered impractical for the method of cutting. Shipyards, ordnance plants, and tank producers and fabricators are flame-softening armor plate and similar materials in thicknesses up to 12 or 13 in. and at speeds closely approximating cutting speeds. The equipment involved is easily portable, thus eliminating not only costly plate handling facilities, but also the necessity for large furnaces. Floor space requirements are thereby reduced.

Flame descaling has been used extensively in the finishing of armor and armored combat vehicles and is now being adapted to gun, shell, and bomb production where previous cleaning methods have proved inadequate.

Flame descaling applications in steel mills have increased as a result of increased production and the need for faster methods. Tests on heat treated steels have shown that neither flame descaling nor flame priming prior to painting affects the heat treatment of the most sensitive steels. In this connection, it was shown that, on flame descaled surfaces, heat treatments were more effective because of the increased rate of heat transfer. Welding of the surfaces is more rapid due to the cleaner condition of the steel.

The improved corrosion resistance of steel surfaces treated by flame priming as compared with other methods has been further indicated during the past year by exposure tests of large, treated structures, and also by published results (Oct. 22 and 29, THE IRON AGE) of additional panel tests.

Supply Trains Roll with the Help of ACP Products and Processes

Automotive manufacturers who have converted for war know the help they can get from ACP Products and Processes . . . Chemicals and their applications which grew with and contributed so much to the mass production of American automobiles.

DEOXIDINE, the acid cleaner which made mass production of all-steel auto bodies possible, is doing its war-time job on the Army's prime movers . . . preparing steel perfectly for painting, eradicating rust and neutralizing rust-producers.

KEMICK holds to and protects metal surfaces even when heated to redness . . . has been used all over the world on exhaust manifolds.

FLOSOL wets oily surfaces, is an exceptional soldering flux for steel, brass, copper, tin, terne plate and zinc.

These three are typical of the many ACP Products and Processes, well known in peacetime, that are serving in the war effort.

•

Others include: RODINE, the pickling inhibitor that saves steel and acid, prevents pitting and embrittlement; CUPRODINE that provides a dense, bright copper coating on steel by simple immersion; LITHOFORM for coating galvanized iron before painting to prevent peeling and scaling.

These are typical ACP Products. The experience of the ACP laboratories in metal treating and finishing processes is at your service.

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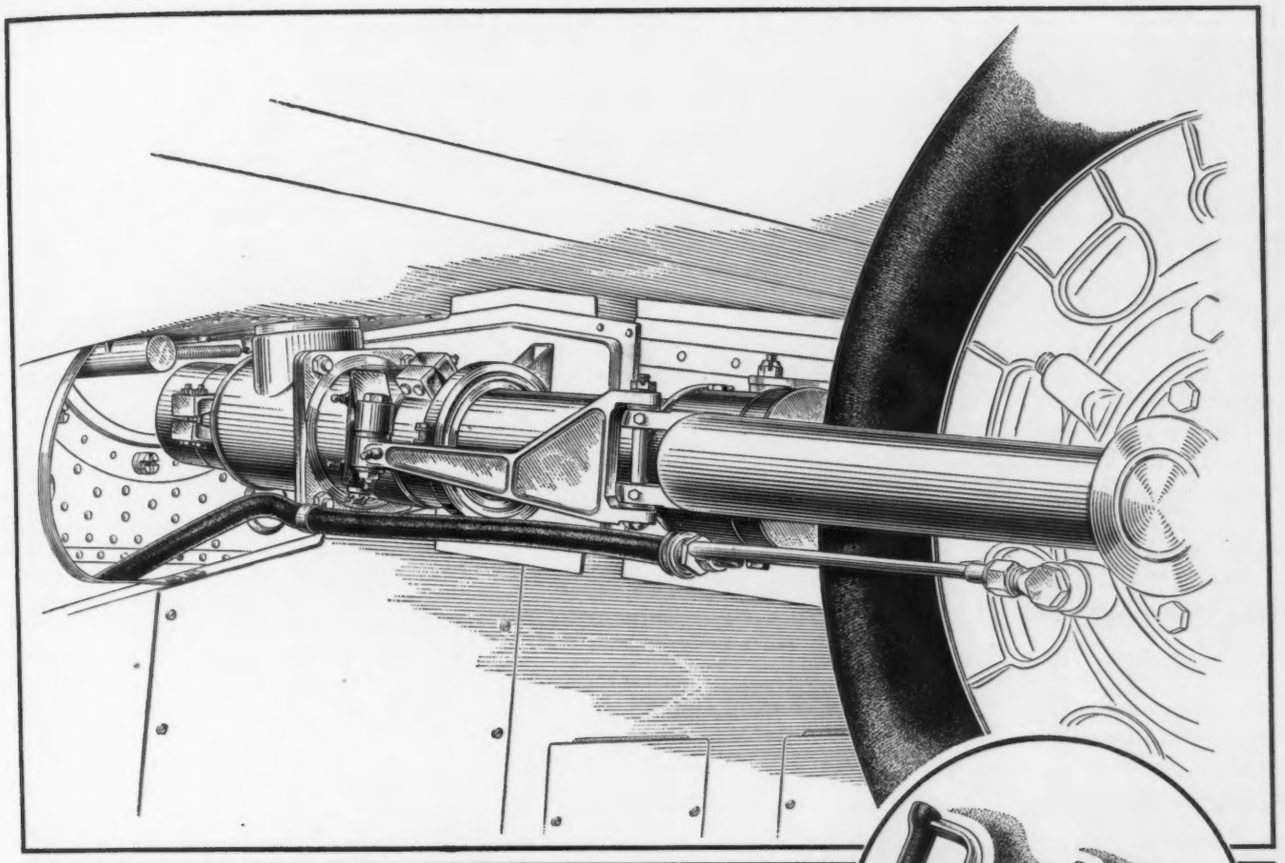

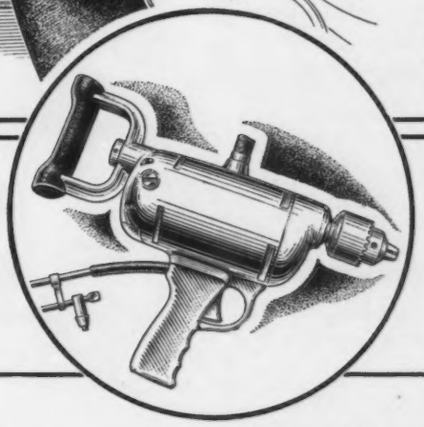

what the Landing Gear Learned from the Portable Drill

IT'S A LONG WAY from portable tools to fighter planes—but an idea that works in one often proves just as good in the other.

That's the way it was with the Torrington Needle Bearing. Portable tool builders quickly saw how its unusual features could be used to cut excess ounces out of their product designs—where *every* ounce counts in conserving the operator's energy, in increasing his efficiency.

These same weight-saving features also caught the attention of the airplane designers. When they needed a bearing that would give easy operation to retractable landing gears...stand up under the terrific impact when three tons of fighter plane hits the runway... and still meet the rigid weight requirements of fast, maneuverable aircraft, they found just what they wanted in the Needle Bearing's unique combination of low friction coefficient, high load capacity, and small size—plus its ready availability for war applications. That question of size is doubly important when it comes to weight economies. It means light weight in the bearing itself, of course. But much more important is the fact that housings and other parts can also be made smaller and lighter.

ISN'T THERE AN IDEA HERE FOR YOU TOO, as you get your post-war designs under way? This light-weight trend looks increasingly important, with freight-by-air looming up as the coming means of shipment. While you're studying ways to conserve weight in *your* products, see how well the Needle Bearing fits into your problem. You will find the preliminary information you want in Catalog No. 104—and Torrington engineers will help you in adapting the Needle Bearing to specific applications.

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Established 1866 • TORRINGTON, CONN., U. S. A.

Makers of Needle and Ball Bearings

New York Boston Philadelphia Detroit
Cleveland Seattle Chicago San Francisco
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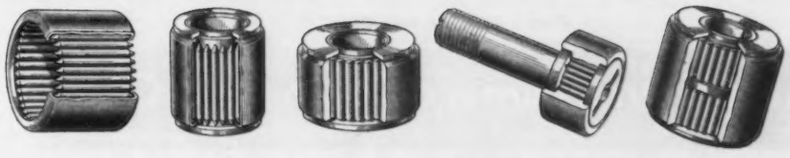
LET'S GO, U.S.A. BUY WAR BONDS

TORRINGTON NEEDLE BEARINGS

KEYED TO TODAY'S NEEDS

AND TOMORROW'S TRENDS



Non-Ferrous Metals

(CONTINUED FROM PAGE 147)

cent of other grades of metallic zinc. As the year wore on, the list of restricted zinc items grew longer and longer. There is no more zinc for such "essential" civilian uses as mason jar tops and fuel-saving weather stripping.

For the zinc industry, the whole emphasis of war has been on output, with a minimum of energy directed toward technical development. Some uses that were quantitatively minor in the past have, however, blossomed into fine, luxurient flower.

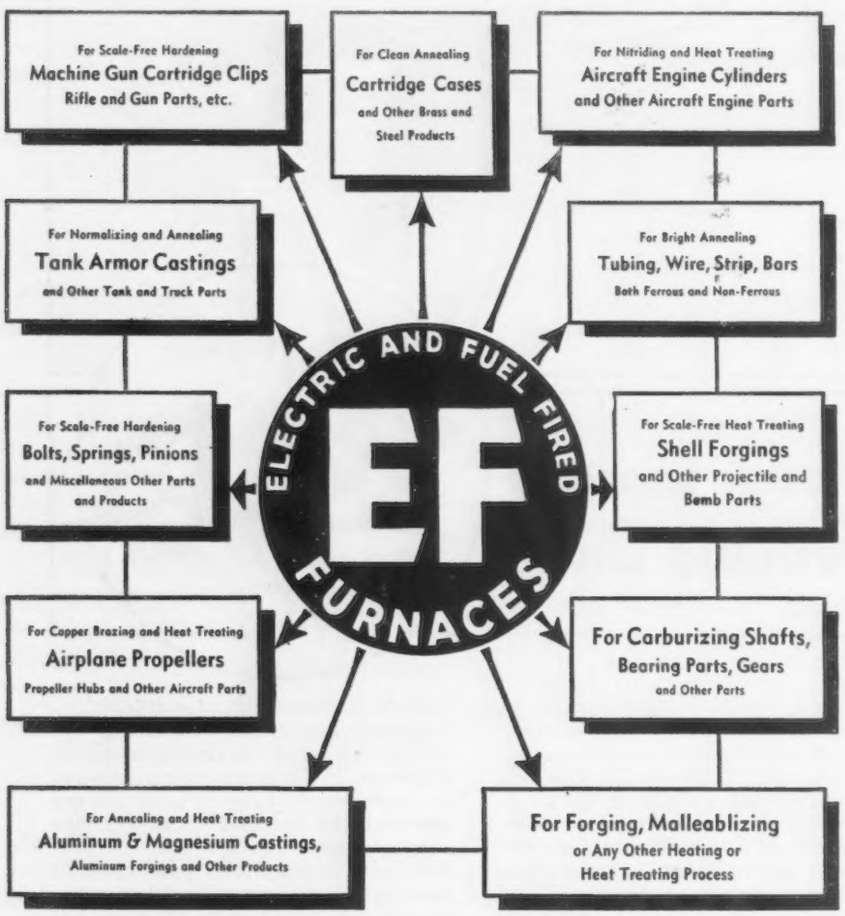
With the growth of the aircraft industry, the use of zinc alloy stamping dies has also grown. These dies, originally employed in drop hammer and hydraulic press work, are now also used in blanking and forming operations in punch presses. Zinc die castings have been adapted in a hundred ways. They are used for bomb noses, shell and fuze plugs, fire extinguishers, anti-aircraft sights, jeep parts and personal hardware, such as buckles (to replace brass). Zippers, now a great war gadget, used on everything from flying boots to tank covers, are largely die cast. The production of flat galvanized sheets, which has fallen off, is mostly for marine use, and in some cases even they will be replaced by painted sheets.

One new furbelow for the industry to wear is its designation as a coin metal. If the Treasury has its way, copper pennies will be replaced with zinc coated steel.

Domestic production of zinc last year, including the output of American Smelting & Refining Co.'s plant at Rosita, Mexico, was probably about 990,000 tons. American Smelting & Refining built a new 30,000-ton plant at Corpus Christi, Texas, which began producing late in the fall, and added 19,200 tons at Amarillo, Texas. Anaconda added 45,000 tons of electrolytic capacity at Great Falls and Anaconda, Mont., which was to have begun producing by the end of the year but now is expected to begin operation this month. American Zinc, Lead & Smelting Co.'s plant at Monsanto, Mo., which went into operation last year, had its 18,000-ton capacity doubled, the new units to begin production this month, also.

No more smelting and refining expansion is planned. What is operating now or in the blue print stage is considered adequate, and this year's push must come in mine production, with its limiting factor of manpower. Domestic ore production last year was probably a little less than 1941's 1,600,000 tons. Imports of 400,000 tons of concentrates were said to be about the same.

In July the Bureau of Mines enthusiastically reported plans for a $850,000 pilot plant and laboratory to conduct commercial scale tests of a gas reduction process developed by the Bureau for production of zinc from large, untouched domestic ore reserves. The plant was to have had an output of 500 lb. of metallic zinc a day, under a process which involves roasting of the zinc concentrates to remove sulphur; heat-



Increased production and uniformity; the saving of valuable time, labor and metals and other advantages have been effected by recent EF continuous automatic, semi-continuous and batch type furnace installations.

The Electric Furnace Co. specializes in designing and building production furnaces and time and labor saving material handling equipment. Years of practical furnace building experience have enabled EF engineers to develop some outstanding production furnaces for handling the above materials and many other essential war products.

Submit your production furnace problems to EF engineers.

Phone 4661 Salem, Ohio

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Gas Fired, Oil Fired and Electric Furnaces---For Any Process, Product or Production

Casting Steel... THE STRONG WAY!

The flash of the camera's eye brings you into the Strong plant at that dramatic moment when a succession of molds are being poured in the Strong manner. Such a picture obviously could not be "staged" even in these days of photographic wizardry. Consequently it is our thought that by mailing you from time to time similar pictures of Strong operations you will gain a clearer appreciation of the better steel casting that takes place any working day in the exceptionally equipped plant of the Strong Steel Foundry Company.

Whenever you have occasion to think of steel castings, remember that STRONG castings are all that their name implies . . . in precision, tensile strength, ductility, elongation, heat treatment, laboratory control, adherence to specifications, cleanliness and machinability. As this first folder of a forthcoming series comes into your hands, we would also like to add our "strongest" wishes for a year of continued progress for, no matter what happens in the year ahead, may we all hold fast to that faith in America's productive genius which we know will ultimately return this world to a life of sanity, peace and plenty.

STRONG STEEL FOUNDRY COMPANY · BUFFALO · N · Y ·

ing, with methane burners, of retorts in which the ore has been placed and methane added; and condensation of the resulting zinc vapor into metal. The Bureau considered its method a distinct departure and a highly advantageous one. The project, however, was one of many whose construction was barred by a WPB order. The Bureau has made an appeal and believes it will soon get an O. K. The plant's location has not been definitely decided upon but it probably will be Rollo, Mo.

Some of the zinc mines lost as many as a third of their men to the Army and to better paying industries. Smelters and refineries had the same trouble. One refinery was reported able to turn out 800 tons a month more, if it had the men. Zinc mines were third fiddle (after copper and molybdenum) for miners furloughed from the Army, but it was reported that even while the tiny dribble of furloughed men fed in, other miners, incredibly, were drafted and leaked out.

Skin of the Teeth:

"Lost by enemy conquest" is the brief and inexorable reason for the tin shortage. No more tin from Malaya, Thailand, or the Netherlands East Indies. No consolation that the enemy doesn't have enough, either. The Japanese have enough tin to build Straits pagodas.

If it weren't for the development of electrolytic plating the tin fix would have been frantic instead of merely desperate (See THE IRON AGE, April 30, 1942, p. 29). However, with this, the government's Tin Commandments, the new Longhorn smelter in Texas, and dribbles from here and there—the Belgian Congo, reclaiming plants, and a stockpile on the pathetic side—the country is scraping along.

At the end of 1941 there was a fine stockpile—on order and contemplated order. The Metals Reserve Co. was talking about a 200,000-ton pile of refined tin and a 278,545-ton pile of ore and concentrates, but the way it turned out was a 35,000-ton pile of tin and about 27,000 tons of high grade Dutch ore, to sweeten up low grade ore from Bolivia.

Viewed with hindsight, this was terrific mismanagement. However, after the worst had happened and the horse was stolen, the colt, at least, was cherished. Viewed also with hindsight, the materials of disaster were handled with skill, once that was all there was left.

The Texas smelter with the fine, swashbuckling name was planned, originally, for an 18,000-ton annual capacity. In April when production began, at an unspecified but low rate, the RFC announced the smelter would be expanded to a 52,600-ton capacity. Production now is probably at a 25,000-ton rate.

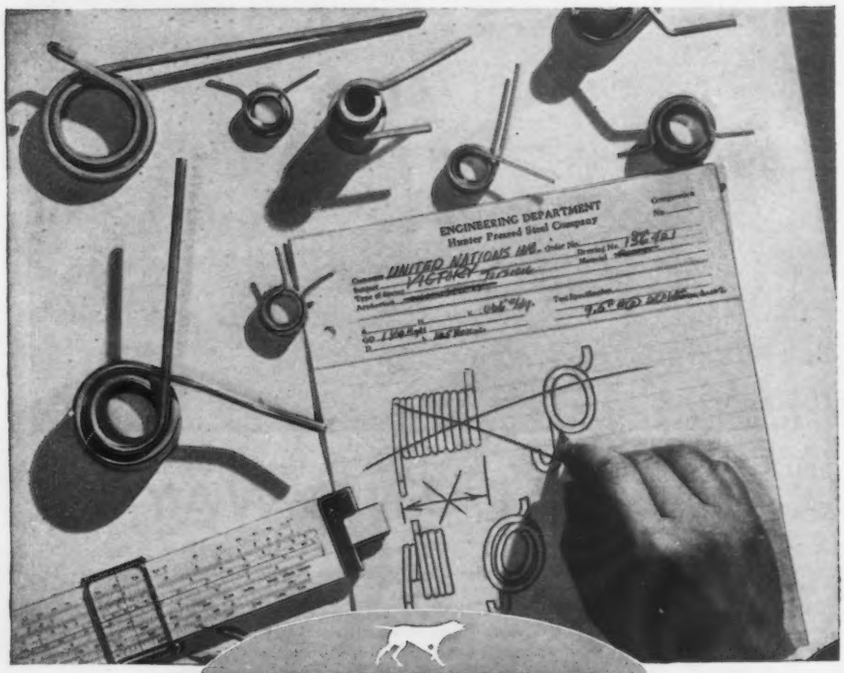
This smelter, the only one in the Western hemisphere, will be the world's largest. MRC says tin will continue to be smelted there after the war. During the last war, two smelters were built, but they were abandoned because of high costs. The Longhorn's gulf site was especially chosen because of low fuel costs and cheap hydrochloric acid.

So far, Longhorn tin is high grade, but the good Dutch ore currently being mixed with Bolivian imports won't last forever. In fact,

The SPRING that WINDS ITS TAIL on ITS BODY

AT TIMES only a torsion spring will do. And only a unique torsion spring at that . . . such as one of the "double-coil" torsion springs below. You see, to achieve proper spring length where the retaining pin or shaft is short, these double springs are coiled over themselves like thread on a spool. Their advantages? Well, apart from their suitability to close quarters, they have other advantages over single-coil torsions, notably—stress is lower, or force is greater, or deflection is greater—assuming that the other two of the three factors are fixed in value. Then again, the double coil inspires a variety of pin locations to avoid interference . . . Why do we point all this out? Simply to indicate the complexities of spring design and specification. There is only ONE right spring for the job—the one made possible by science in springs.

IN THE ARMY NOW... *Springs have gone to the front in a number of ways Hitlerito and his Nipponazis would like to know. If you need springs, or fighting equipment, our men will be only too glad to make them or design and make them. Just say when!*



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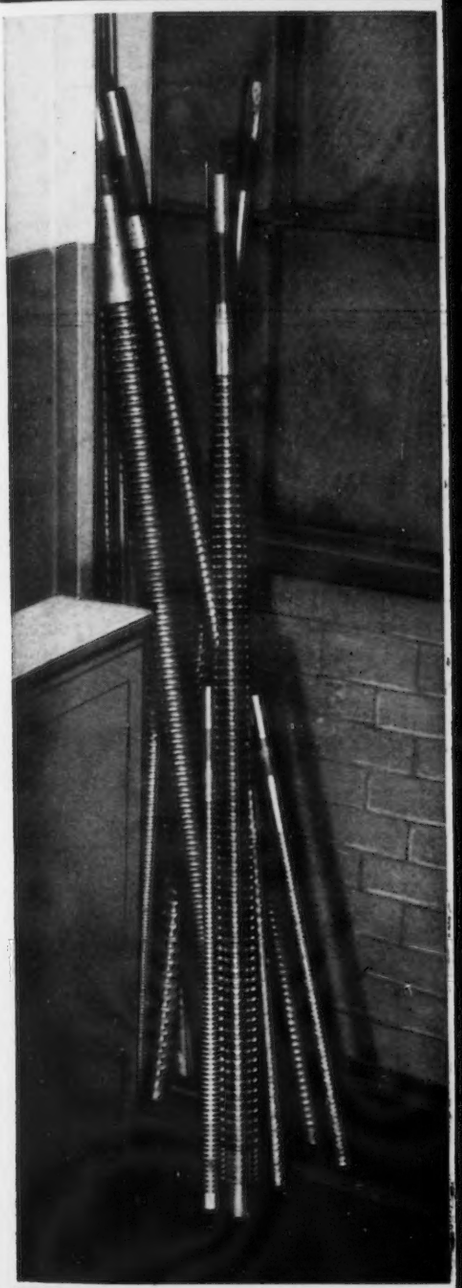
Science in Springs

HUNTER PRESSED STEEL COMPANY, LANSDALE, PENNSYLVANIA

THE QUICKEST WAY TO SPOIL GOOD BROACHES . . .



. . . Lean them against each other in a corner

How to get more production with your Broaches------

1. BY PROPER HANDLING

IT TAKES time to recondition a damaged broach. Careless handling of your broaches may tie up production. Here are a few good rules to follow to protect these vital war tools:

(a) Always provide individual storage racks for broaches. These should either be of a material that will protect the teeth from damage or else should be lined with such material. If cutting edges of broaches are allowed to strike against each other they may be chipped or nicked.

(b) Never drop a broach on any hardened surface. Broaches are usually made of high speed steel and may even be tipped with tungsten carbide. You may chip, nick, or even break the teeth.

(c) When broaches are to be stored for any period of time they should be treated to protect them against corrosion.

(d) Equipment for moving broaches from one department to another should have separate compartments to prevent nicking of broach teeth.

COLONIAL broaches are designed to enable you to machine your parts more accurately, quicker, and at a lower tool cost per piece than with virtually any other method of stock removal. Give them a chance to do an all-out job for you. Handle them carefully.

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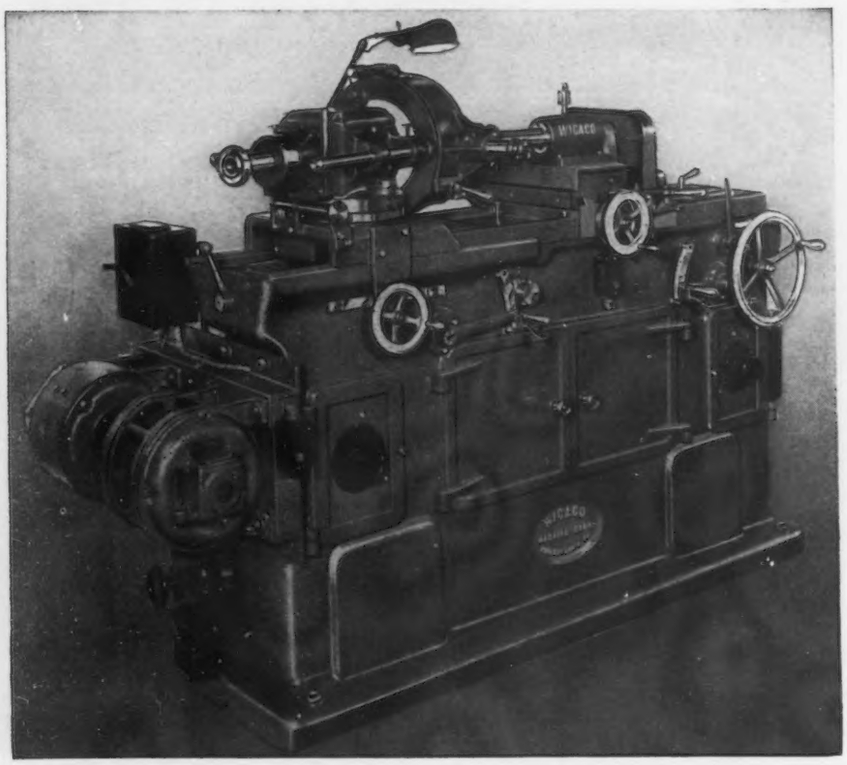
Broaching Machines — *Broaches-Broaching Equipment*

DETROIT . . . . . U. S. A.

WICACO

INTERNAL GRINDER



Wicaco Performance helps win the Battle of Supply . . . a background of 75 years of constructing fine machine tools . . . plus 15 years of specialization in the design and building of the popular Wicaco Precision Internal Grinder result today in a superb tool for the faultless output of thousands upon thousands of munitions parts—for Diesel engines, for Guns, Aircraft engines, Bob sights, Tanks. Wicaco Internal Precision Grinders are available for prompt deliveries under priority regulations.

75th YEAR

THE WICACO MACHINE CORP.

WAYNE JUNCTION, PHILA., PA.

it probably won't last very far into this year, when it will be time for another rabbit out of the hat. Whether there is another rabbit, nobody who will tell, knows. Longhorn's full 52,600 capacity won't be used unless one or more of the other United Nations smelters—in England or the Congo—is destroyed or damaged.

Imports of refined tin in 1942 were less than 10,000 tons, all from the Belgian Congo. In 1941, about 160,000 long tons were imported, of which about 120,000 tons were used.

In 1942, England got about the same amount from the Congo as did the U. S., all the Nigerian ore production (about 15,000 tons) and half the Bolivian ore. The U. S. got the other half, about 22,000 tons for each.

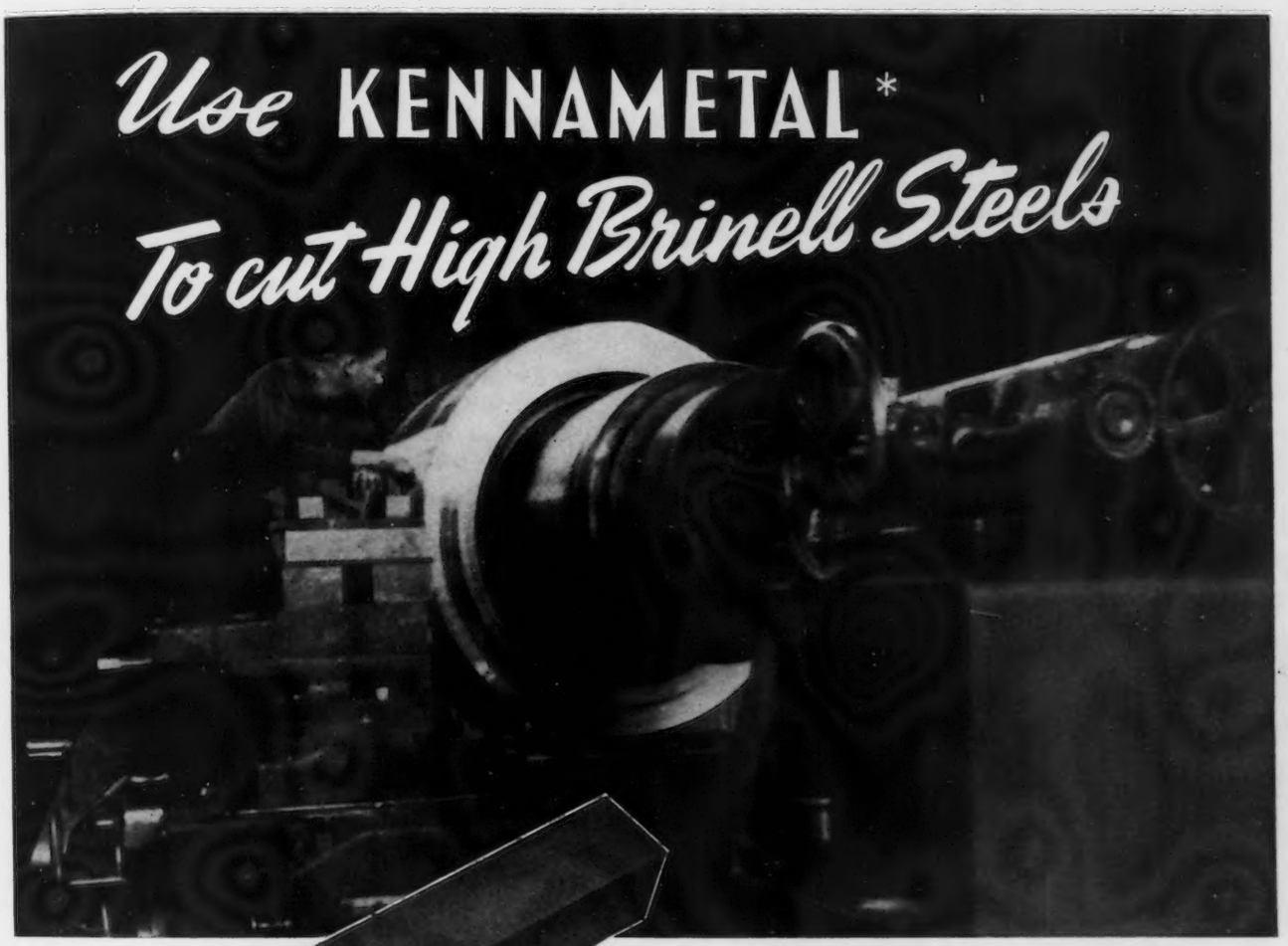
Tin importers in this country were left without even the job of distributing the Longhorn and Congo tin, a function the WPB took over. They did do a little pushcart business, limited to five tons to a customer a month.

While researchers pondered how much more tin is needed for a can of grapefruit than for a can of spaghetti with meat balls, an expansion program of 27 electrolytic tin plating lines and 18 bonderizing plants got under way. The electrolytic lines alone, it is estimated, will cost $75,000,000 but results will be spectacular and quick. This year's consumption of tin for cans will probably be little more than half of last year's 21,000 tons The saving will amount to 25 per cent of the year's demands and to 10 per cent of a peace-time year's consumption. Only 5 per cent of this year's cans, the WPB says, will use the old 1.5 lb. coating.

Bonderized plate will be used mostly for ends, rather than for ends and bodies. An all bonderized can needs tin-lead solder, but silver-lead can be used for a combination electrolytic-bonderized can.

The detinning expansion program which got under way late in the year includes plants in 28 cities, some for shredding, and some for shredding, cleaning and detinning. Eight veteran detinning plants had already been in operation and these took care of 1942's first faltering detinning steps, turning out a product 99.9 per cent chemically and metallurgically pure. As the tin on electrolytically plated cans travels its phenix cycle, the proportion

Use KENNAMETAL* *To cut High Brinell Steels*



STYLE 11 TOOL

By using KENNAMETAL tools for machining High Brinell steels it is not first necessary to reduce the hardness of the work piece, complete the machining, then reharden the job for the finished product: KENNAMETAL will cut right through steels up to 550 Brinell.

KENNAMETAL is a fine-grained carbide cutting tool that will not gall or crater from hot chips consequent to machining hardened metals. High Brinell steels demand a hard cutting material; KENNAMETAL has a Rockwell C hardness of 77.6, Rockwell A 90.8 and has a transverse rupture strength of 305,000 lbs./sq. inch.

KENNAMETAL CUTS 1¼ MILES OF HARDENED STEEL IN 80 MINUTES

The illustration shows a Style 11 KENNAMETAL tool machining high carbon steel (401-427 Brinell) at a speed of 80 feet/min. at a feed of .032"; depth of cut 0 to 1". The tool cut 1¼ miles of this hardened metal before regrinding was necessary.

KENNAMETAL not only cuts hardened steels which ordinary carbides cannot machine—it consistently increases production on steels of any hardness. Use it for all your steel boring, turning, and facing operations; there is a tool for your particular application.

Write for your copy of the new KENNAMETAL Catalog, No. 43.

*INVENTED AND MANUFACTURED IN U. S. A.

KENNAMETAL THE All American CARBIDE

McKENNA METALS Co.

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of tin yield to cans treated will, of course, constantly decrease.

Metallurgists got out their best brain cudgels in 1942 to work on tin thrift. Copper-silicon-iron and copper-silicon-zinc bronzes began to replace tin bronzes. Lead-base babbitt bearings with a tin content of no more than 12 per cent were prescribed by WPB, except in particular instances specified by the armed services. Antimony and silicon were substituted for tin in castings, the tin content in solder was cut down or it was eliminated altogether in favor of 2.5 per cent silver and 97.5 per cent lead; cadmium was used in bearings, and lead took the place of most of the tin in collapsible tubes.

The White Crow:

Of all the important non-ferrous metals, only lead is fat and happy. While other metals go under tighter and tighter control, lead restrictions are loosened. While other metals must give way to substitutes, lead moves into the manicured society where it never moved before. While other metals must skitter from hand to mouth, lead can rest peacefully and long in inventory.

This affluence doesn't mean lead is being frittered away. It is used only for war work and essential civilian industry, but it spreads out over these fields without scrimping and the government stockpile constantly grows. The stockpile is said to contain "more than a year's military requirements," the sort of vague statement that now substitutes for statistics.

Last winter, after an orgy of lead substitution for tin and aluminum foil and copper pipe, and no verboten on nonessential use, it looked for a while as though the wolf were at the door. Restrictions were clamped on. But in the meantime, a lot of the best lead customers, such as the private building and automobile battery industries, went into duration hibernation, and imports from Mexico, Australia, Canada and Peru were above hopes. By August, it was said that 30 per cent of production and imports were going into the stockpile; by September, 40 per cent.

From then on, reminders that lead could be used as a substitute for other metals were dropped frequently by the government and the lead industry, and in November a long awaited and much heralded amendment to the WPB lead order was issued, loosening lead restrictions. Since lead wasn't being used even up to the pre-amendment allowances, the effect of the loosening was supposed to be mostly psychological—a particularly ostentatious reminder that lead is available.

In spite of all the reminders, however, and much experimenting and scurrying by both the industry and the government, no large scale substitutions have yet been made. It just isn't easy to pinch-hit with the most durable but the softest of common metals.

One big new field for lead, it is hoped, will be foil for dehydrated food. Corrosion protection coatings is another. Lead-calcium-tin-magnesium alloys (99.75 per cent lead), developed before the war, are getting a boost. Since they can be used in thinner sheets than unalloyed lead, they compete in cost with

IN thousands of varied shapes "fighting wire" is on the war fronts. In bombs and shells; in tanks and guns and planes; in equipment and war material of many types, you'll find wireforms and springs doing a thousand-and-one vital jobs.

Above, you see a few of the many Accurate-made special wire shapes which are parts of fighting implements. They're produced in huge quantities to Accurate precision standards — under rigid control from raw materials to inspected finished products.

Accurate "know-how", based on experience and specialization, can help you solve your production problems that involve springs and wireforms. Tell us what you need and when you need it—it's as simple as that.

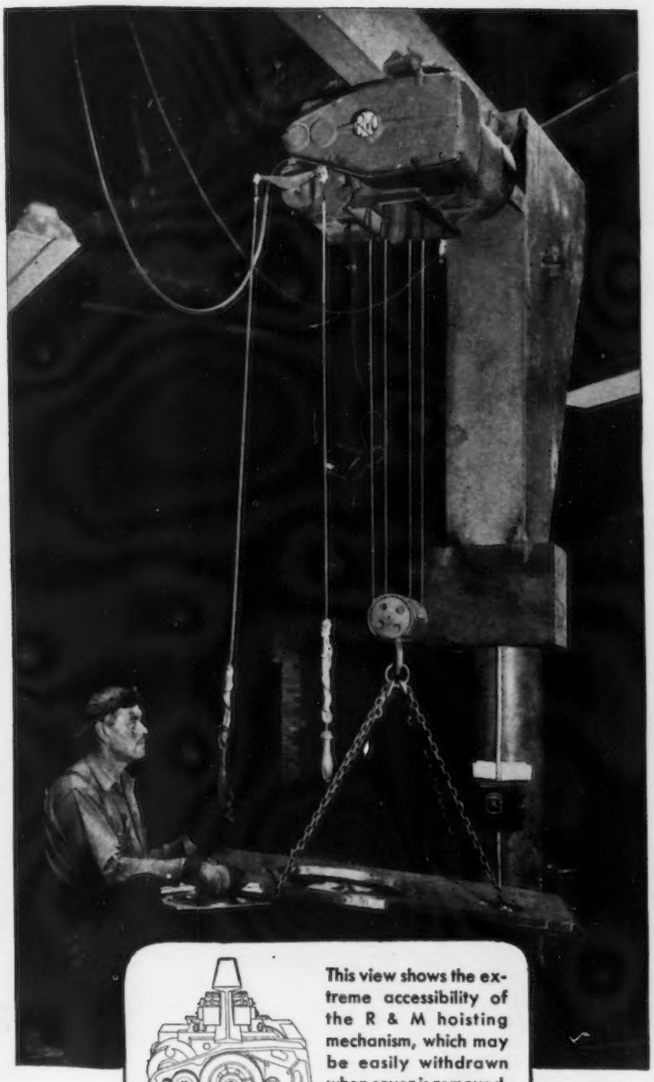
WHAT SPECIAL WIREFORMS DO YOU NEED?

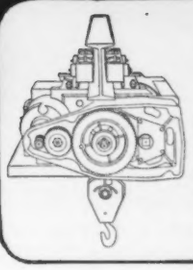
Accurate Springs

Free "Handbook on Springs". Send for your copy today. It is informative, compact, handy to use.

ACCURATE SPRING MFG. CO., 3819 W. Lake St., Chicago, Ill.

12 R & M HOISTS Speed this Firm's War Work!





This view shows the extreme accessibility of the R & M hoisting mechanism, which may be easily withdrawn when cover is removed. Note also the compact design that provides low headroom and maximum lift.

What's the fastest, surest, most economical method of handling weights ranging from 50 lbs. to 1500 lbs.? This was the problem that confronted Chicago Vitreous Enamel Product Company's production engineers when they converted to the manufacture of steel and armor plate.

They found the solution—as have engineers in countless war plants—in a fleet of 12 R & M All-Steel Hoists. In their inspection, flame-cutting and testing departments, and throughout the plant, these performance-famous hoists are keeping production *climbing*—with complete safety and minimum maintenance.

Here's why. R & M All-Steel Hoists are precision-built from track to hook; they're powered by famous R & M motors; they're perfectly balanced; they're equipped with an oversize oil-cooled automatic load brake. Hundreds of R & M models, ranging from ½-ton "Davids" to 7½-ton "Goliaths," are available to fit every application.

Whatever *your* hoisting problem, "take it up" with R & M! Our expert representatives will help you find the solution. Call the nearest R & M sales and service office, or write us at the factory.

R & M HOIST AND CRANE SALES AND SERVICE OFFICES

Albany.....364 Broadway
Atlanta.....319 Walton Bldg.
Baltimore, Lombard & Concord St.
Boston.....74 Needham St.
Chicago....2400 W. Madison St.
Cincinnati.....418 New St.
Cleveland..470 Rockefeller Bldg.
Denver.....1420 16th St.
Detroit....2921 E. Grand Blvd.
Houston..3715 Harrisburg Blvd.
Jacksonville....305 Bisbee Bldg.
Montreal.....Lyman Tube & Supply Co., Ltd.
Newark.....700 Bergen St.
New York.....200 Varick St.
Philadelphia.....401 N. Broad St.
Pittsburgh.....H. W. Oliver Bldg.
Providence.....44 Clifford St.
San Francisco, 116 New Mtgmry. St.
Seattle.....216 Walker Bldg.
Syracuse....204 State Tower Bldg.

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copper for such uses as roofing and flashings.

1942's lead production was about the same as 1941's, which was 1,086,000 tons. The year started out better, but manpower shortages cut production, and in some cases men from lead smelters were moved to copper smelters owned by the same company. Hardly any over-quota premiums were paid lead producers until quotas were liberalized late in November. There was no mine or smelter expansion. Production this year will probably remain about the same, but imports from Australia and Canada will be smaller; England is asking for a bigger proportion of their output.

Procrustean Bed:

Last year nickel had to stretch a long way. This year it will have to stretch still farther but the pangs, dulled by the anaesthetic of NE steels, should be fainter.

The stretch is a mighty one. In 1937, one ton of steel in every 17 was an alloy; in 1942, one ton in every 6½ was alloy. This year the government expects to need 18,000,000 tons of alloy steels and, even with increased production and drastic restrictions, we have sufficient alloying agents for only 8,000,000 tons of conventional alloys. The solution, of course, has been unconventional alloys.

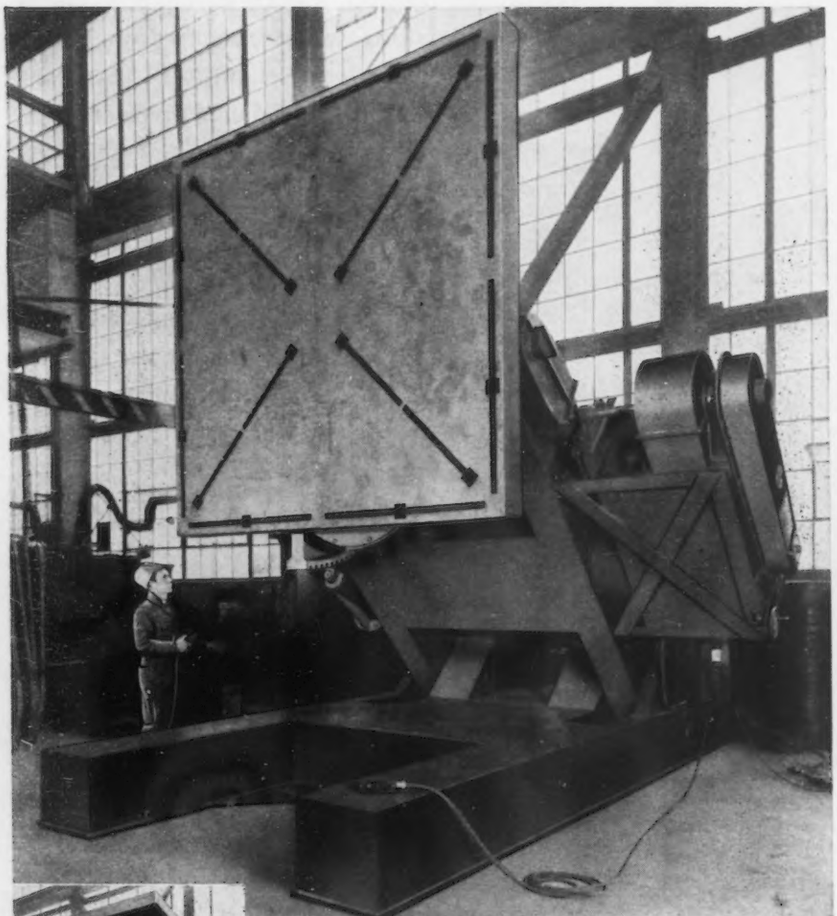
Nickel was one of the first of the non-ferrous metals to be shortage-smitten. In peacetime, 70 per cent of U. S. consumption of the metal was in steel. By the beginning of 1942, when nickel had already been under priorities for eight months, the percentage was much higher, with nickel plating, nickel silvers, monels, nichromes and chromels all disappearing. Even so, there were times early in the year when steel makers were really hard up for nickel.

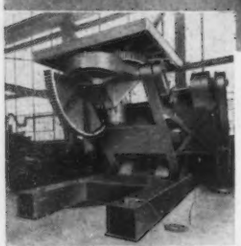
NE steels, with their huge savings of nickel and vanadium, were announced and first produced in May, but the first heavy production was in August, when they made up 30 per cent of the alloy production. In August a new and still more economical series was announced. The monthly production has since reached as much as 50 per cent, and will of necessity go higher. The proportion will fluctuate quite considerably month to month, depending on fluctuating emphasis on gun steels, for example, which are still high-nickel.

High manganese austenitic steels (see THE IRON AGE, Oct. 1, 1942, p. 51) were found last year to have strengths equal to the best of stainless steels with no serious loss in ductility. These steels, extremely promising for light weight construction, have nickel contents up to 2 per cent, compared with 7 or 8 per cent for stainless.

Virgin nickel is now used almost entirely for high-nickel steels. The NE steels get their vitamins from scrap and thereby hangs a tale of reclamation and segregation. Last spring the job of segregating machining and fabricating scrap was almost despaired of. The care, watchfulness and ingenuity required were tremendous. One aircraft company spent $90,000 just on equipping itself for such segregation and for the follow-up of cleaning, baling or briquetting. At present, very little nickel steel scrap

(CONTINUED ON PAGE 288)





NEW 30,000 lb. C-F POSITIONER "Boom-type" Base

Now a giant C-F Positioner that has not only the capacity needed for shipyards and heavy machinery and equipment builders, but a new design boom-type base that permits adjustment of table height from 6'0" to 16'6" so that maximum floor and working clearance is assured for even extremely large and awkward shaped work. Mounted on this boom-type base the Variable Speed Rotational Table not only rotates weldment completely around (360°) at any rotational speed, but can be tilted almost completely over thru an arc of 135°, or 45° *beyond vertical*—permits down-hand welding not only of all sides and top but of bottoms too, with a single set-up.

Capacity 30,000 lbs., 24" away from table, 18" off center. Portable Base (Illustrated) or Column-in-floor Base.

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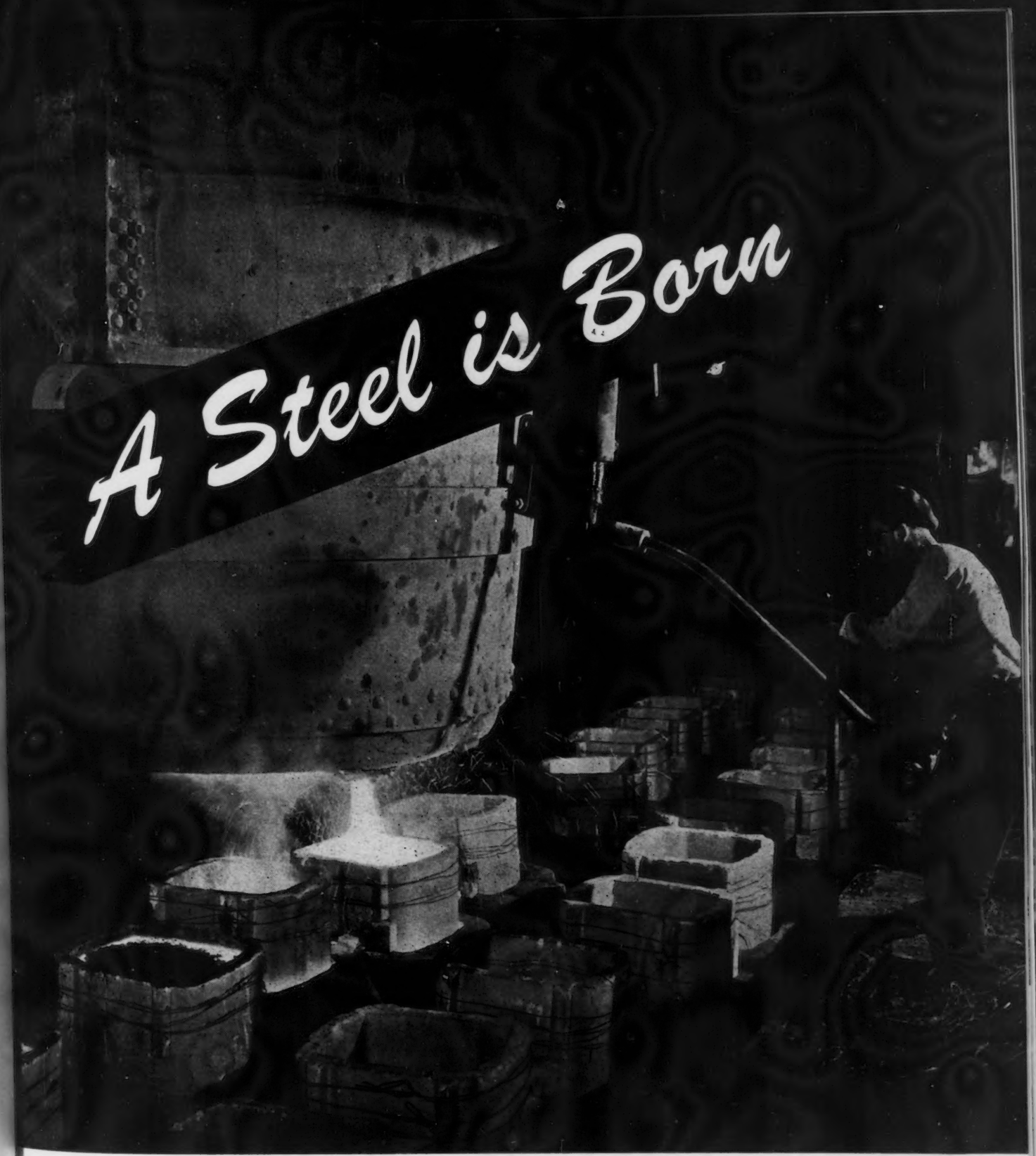
1303 S. KILBOURN AVE. CHICAGO, ILLINOIS



Pouring the first heat of a new "A.W." Alloy Steel is a moment to long remember. The promise of Victory and the vision of a better America are in every hot top ingot. Our first thought today is to produce the best steels possible in the greatest volume for ships, tanks, guns or the equipment which produces them. If you are engaged in war production and have an alloy steel problem, we will do our best to help you. Personal attention has been the keynote of "A.W." service since 1826.

ALAN WOOD STEEL COMPANY

MAIN OFFICE AND MILLS: CONSHOHOCKEN, PENNSYLVANIA : SINCE 1826. District Offices and Representatives: Philadelphia, New York, Boston, Atlanta, Buffalo, Chicago, Cincinnati, Cleveland, Denver, Detroit, Houston, St. Paul, New Orleans, Pittsburgh, Roanoke, Sanford, N. C., St. Louis, Los Angeles, San Francisco, Seattle, Montreal.

Machine Tools Over the Hump

(CONTINUED FROM PAGE 139)

ment reported in potential subcontractor plants.

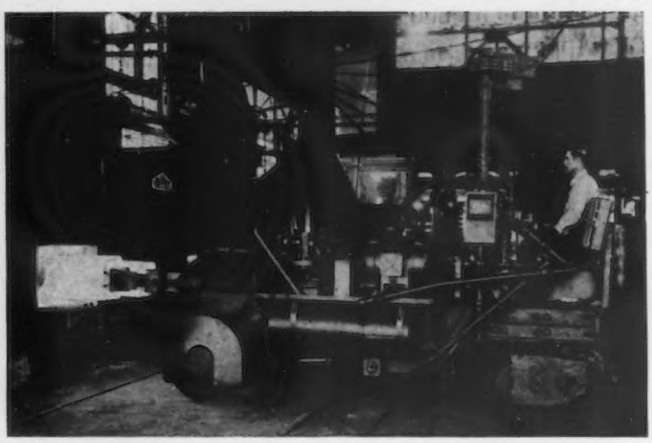
On its part, the Available Used Tools Branch of the WPB has located and placed on card files data on all permanently idle equipment, thus building up a pool of equipment, which all prime contractors have been obliged to draw upon before requisitioning any new machine tools.

Cooperating with the various Ordnance District offices along the same lines has been the Lloyd Machine Tool Panels. Named after N. P. Lloyd, of Lloyd & Arms, Inc., Philadelphia dealer, these local groups, composed entirely of sales engineers of machine tool dealers, in weekly sessions have advised the various ordnance component committees in problems relating to tooling and to availability of machinery. They have located critical machines when production emergencies arose and have saved the Ordnance Department from having to buy thousands of machine tools that would have been available only on long delivery. These dealers actually cut themselves out of the sale of new machinery and would appear to be working against their self-interests. Actually, the dealers have an eye to the future and would just as soon not sell 10 years' volume of machinery in one or two years as long as idle equipment is waiting to do the job.

The dealers long have been the target of some New Dealers in Washington who think the various government agencies should do all their buying direct, not knowing of the large amount of engineering service rendered by dealer organizations and the fact that the majority of the smaller machine tool builders simply could not cover their market adequately without dealer help in widely scattered territories. Only last July a bill outlawing all commissions on sales to government agencies popped up in the House and was passed by voice vote with scant consideration as to its whole implications. Aimed at arms brokers, the bill was worded so broadly as to include all legitimate dealers. Fortunately it has remained buried since then in the Senate committee handling this type of legislature. The disinterested service of the Lloyd Machine Tool Panels has done much to prove the vital part the machine tool dealer plays in the war effort.

o o o

MANIPULATORS



The 6000-lb. Brosius Manipulator shown above is one of many of these machines now being used in the production of war materials. They are designed to manipulate forging blanks under hammers and presses as well as charge and draw the heating furnaces.

All machines are driven by an electric motor, receiving their current from the main plant supply line through a rotating collector as used on the machine shown, or from a gasoline driven generator mounted on the machine.

The operation of the tongs and rotation and tilting of the peel are accomplished through oil cylinders actuated by an oil pump mounted on the machine. The steering of the machine is also hydraulically actuated, eliminating all fatiguing effort on the part of the operator.

Brosius Manipulators are built in capacities of from 2,000 to 20,000 pounds, giving a wide range of designs to meet most any requirement.

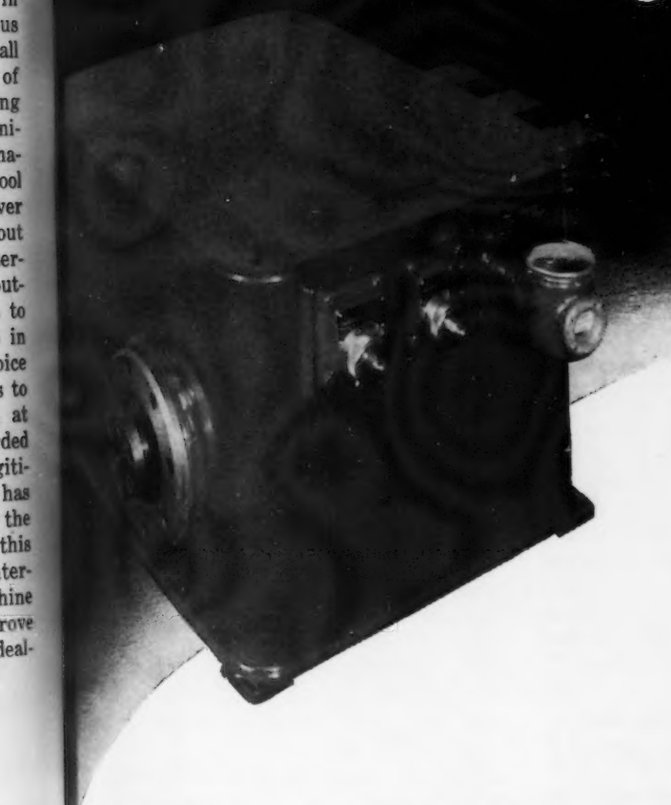
Edgar E. BROSIUS Company

MANUFACTURERS AND DESIGNERS OF SPECIAL EQUIPMENT FOR BLAST FURNACES AND STEEL MILLS

PITTSBURGH, SHARPSBURG BRANCH, PA.

Brosius Equipment is covered by patents allowed and pending in the United States and Foreign Countries

FOR NEW MACHINES OR CHANGE-OVER TO... HYDRAULICS



The power unit illustrated controls six cylinders on a special contour milling machine—four of which are rapid traverse feed and return . . . two are for clamping. The unit provides a complete automatic machine cycle controlled by push buttons and limit switches, which in turn actuate solenoid operated valves. Feed rates are infinitely adjustable throughout the range of the feed control valves.

There are "HY-MAC" Hydraulic Power Units that may be applied to grinding, milling, boring, drilling, piercing, riveting, pressing, etc. . . . it is merely necessary to establish the functions of the machine that are to be hydraulically operated—and our engineers will recommend a Power Unit and a layout of the circuits to best do the job . . . Hydraulics are completely adaptable to any motion desired—for feed and traverse of multiple or single tools . . . for indexing and locating . . . for clamping, etc., all or any of the movements and in any combination. . . . Any designer or builder of machines can adapt their specific design, either partially or completely to "HY-MAC" HYDRAULICS . . . . . .

Our engineers will be glad to make recommendation and preliminary proposal without obligation.

HYDRAULIC MACHINERY, INC.
12825 Ford Road • Dearborn, Michigan

HYDRAULIC MACHINERY

Foundry Research Spurred by War

(CONTINUED FROM PAGE 153)

con and 1 per cent manganese, and PMG metal with 4 per cent silicon and 2 per cent iron.

Good Everdur castings, he reported, have a very narrow range of specific densities—8.37 to 8.40. A variation from this, either up or down, usually indicates a defective casting.

In checking hardness of Everdur, an important quality check, the only effective scale is the Rockwell B. Brinelling is not sensitive enough and if it is necessary to use a Rockwell E scale, the casting is probably no good. The hardness range may vary considerably, say from 62 to 30 without necessarily indicating a bad casting. Interpreting such hardness tests requires considerable experience and fine judgment.

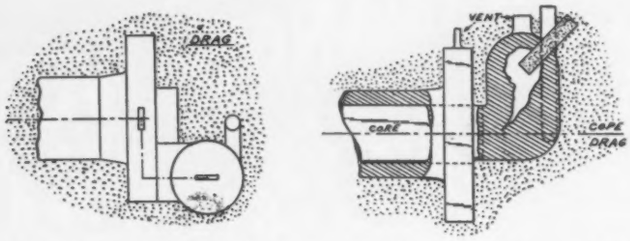


FIG. 3—Top (left) and side view of a typical application of blind risering. The casting is a flange valve. Note the venting core in the riser.

Strength of a large casting will differ considerably in various regions, Corson stated. However, in an arbitration test bar, tensile may reach 55,000 lb. per sq. in. with a 60 per cent elongation, which is close to the alloy's characteristics in wrought and annealed states. Yield point does not vary very much. A good casting may show 16,000 lb. while a defective casting some 13,000 lb.

Chief drawback of Everdur, according to Corson, in comparison with the tin bronzes, is that Everdur has practically no proportionality limits, or in other words, it suffers permanent deformation at a very low load or impact.

Machining of Everdur is rather tricky because it drags as badly as pure copper. It does not take as good a polish nor will it thin as easily as common brass. However, it has good welding characteristics. Corson expressed the opinion that sound castings of Everdur can probably be produced for nearly all purposes where tin bronzes are used today.

Density of PMG is almost the same as for Everdur, except averaging possibly 2 points higher. Hardness of PMG is considerably higher and more uniform than Everdur. A well cast PMG arbitration bar is likely to show 50,000 lb. per sq. in. tensile, but some reduction of this is likely with larger bars. The average for various sections of a bar will probably be around 44,000 lb.

Elongation is rather low, only 11 per cent. PMG is quite similar to Everdur in as far as proportionality limits and yield strength are concerned. However, PMG has less tendency to absorb gases than Everdur and good castings are easier to get. Machinability of PMG is better than Everdur and it also polishes better.

Still another contribution to the effort to overcome the tin shortage is the new silicon-copper-zinc alloy announced last year by Ajax Metal Co. The physical properties of this new alloy, called Navy Tombasil, is listed (THE IRON AGE, July 30, 1942, p. 54) as exceeding the requirements of either government G bronze (88-10-2 or 88-8-4) specifications 46M6G; M metal specification 46B8G, and also the physical properties stipulated in Navy specifications 46B28.

Navy Tombasil is reported as an exceptionally free flowing metal with excellent sand casting properties. Its tensile is given as around 54,750 lb. per sq. in. with an elongation in 2 in. of 44 per cent. This Navy Tombasil (patent No. 1,933,390) carries around 90 per cent copper, 5 per cent zinc maximum, and 5 per cent silicon maximum. Several variations of this mix are available for specific applications.

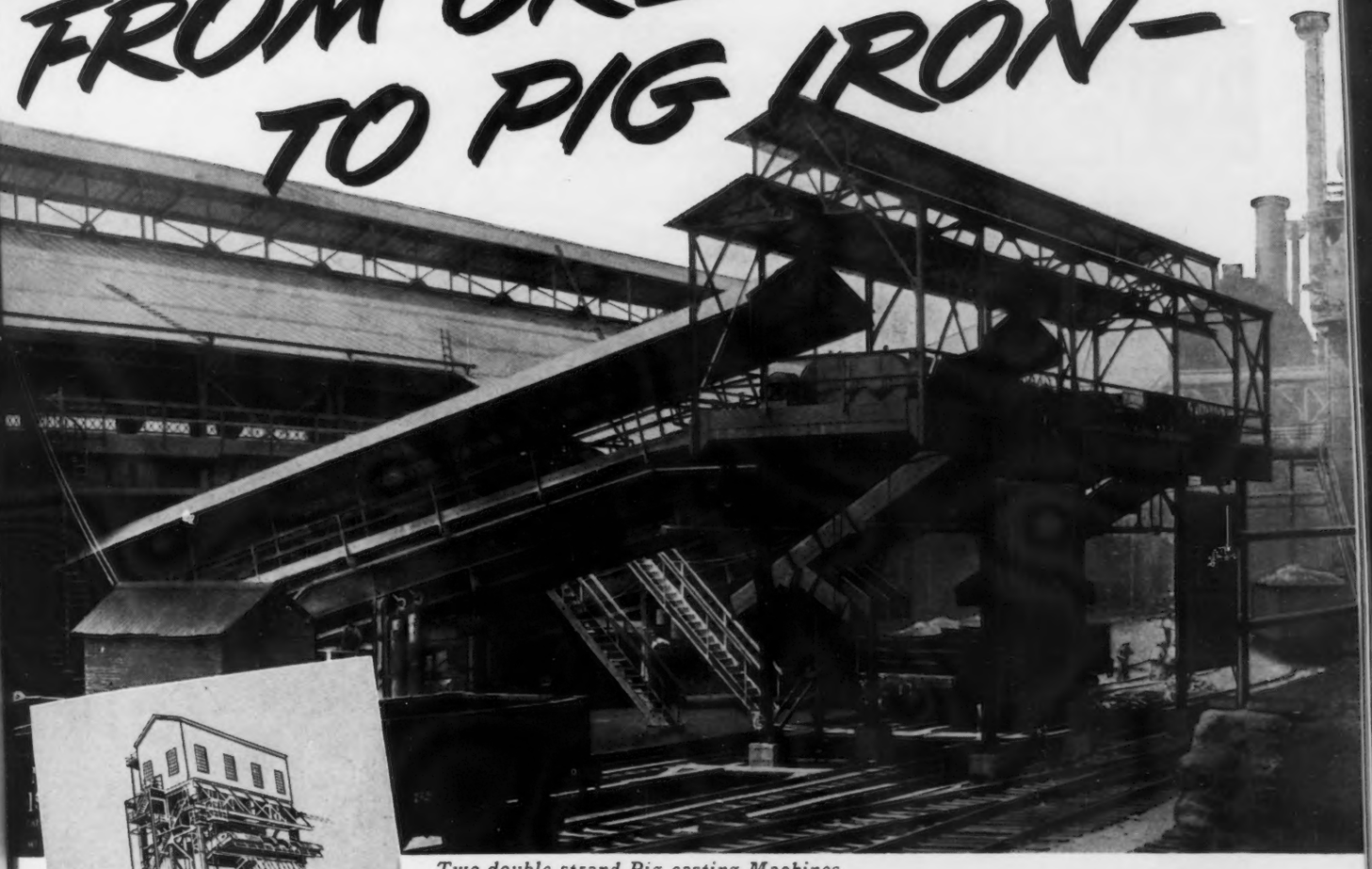
Pouring temperatures are somewhat critical. The average pouring temperature is put at 2000 deg. F. for the Navy type, and lower for other types. Metallurgical control must be close. Applications of this material are already quite varied, including a number of pressure jobs requiring a test with 300 lb. pressure. Melting temperature is also quite critical and varies with the analysis within a small range. Molding and coremaking are not much different from usual practice, but gates should be cut in a manner to produce a choking effect.

The weldability of Cu-Si-Fe bronzes is apparently no cause for difficulty in use. An excellent report on this characteristic has been made by Jennings and Roast ("Copper-Silicon-Iron Bronzes," read at May, 1941, meeting of American Foundrymen's Association). The authors reported that this alloy was readily welded with rods or electrodes of the same composition by the oxyacetylene and electric arc methods. It can also be successfully welded to steel.

The procedure adopted by the authors for producing such welding rods is as follows: The extruded rod electrodes, running 84 per cent copper, 16 per cent hardener, is covered with sodium fluoride-borax flux. A vertical furnace capable of heating a stainless steel tube of 3½ in. in diameter is required. The tube is filled with flux to a height of 14 in. The flux consists of 90 per cent fused, powdered borax (sodium borate) and 10 per cent powdered sodium fluoride. These dry powders are well mixed and then poured into the stainless steel tube. A furnace, which should be well insulated and fired with gas and air under pressure, or better still, a resistance type electric furnace well insulated and controllable within ±20 deg. F. is required. This furnace should be capable of heating a stainless steel tube 3½ in. in diameter. Such a furnace may be kept at 1500 deg. F. readily both at the bottom of the tube and throughout its height.

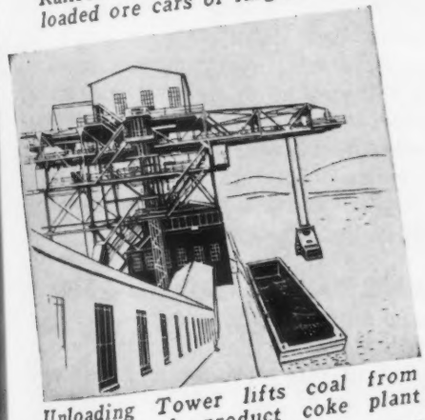
The electrodes are immersed in the flux and are slowly and carefully removed so that the flux runs down the rod and back into the tube. It is essential that the rod be held as truly vertical as possible

FROM ORE TO PIG IRON—

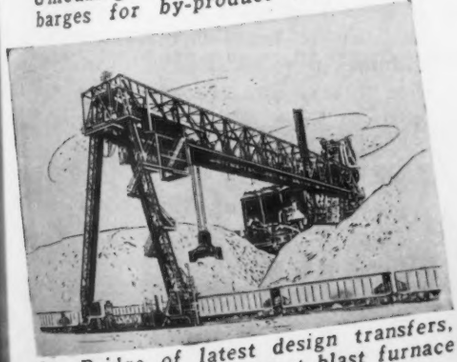


Two double-strand Pig-casting Machines designed and built by Heyl & Patterson

Railroad Car Dumper lifts and dumps loaded ore cars of largest size



Unloading Tower lifts coal from barges for by-product coke plant



Ore Bridge of latest design transfers, stores and reclaims ore at blast furnace

HEYL & PATTERSON ENGINEERING Speeds Flow of Materials

Long before the iron from the blast furnace drops from this pig-casting machine or moves to the open hearth, Heyl & Patterson materials-handling equipment is already performing such service-of-supply operations as dumping ore from railroad cars . . . unloading coal for the by-product coke plant . . . moving ore with a traveling bridge.

Each of these handling problems is quite different, yet each piece of handling equipment for such jobs has one built-in feature that contributes to unfaltering production—Heyl & Patterson Engineering.

We, at Heyl & Patterson, look forward to making this specialized type of engineering serve you in 1943.

HEYL & PATTERSON INC.

50 WATER STREET PITTSBURGH, PA.

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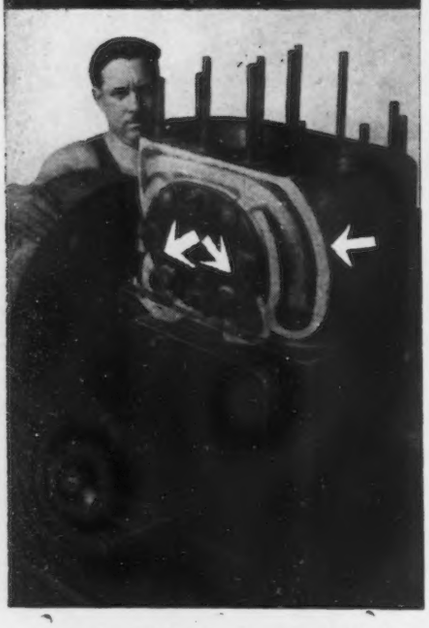

Large two cylinder air compressor with badly cracked water jacket. Salvaged with Castolin Eutectic Low Temperature Welding Alloy. No general preheating. Time: 1½ hours.

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WHY waste time and materials? Reclaim broken, cracked, worn or defective castings, easily, economically. Use Castolin Eutectic Alloy #14 (gas welding) and Castolin Eutectic Alloy #24B (AC-DC metallic arc). These new low temperature welding alloys assure you of a completely machineable, color matching, stress and distortion free weld every time.

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and over the center of the tube containing the flux in order that the cooling may be the same all around and a coating of uniform minimum thickness obtained. The thinner the coating the better. No draft should be playing around the furnace which would have a chilling effect.

The flux generally gets black in color in the furnace and the coating runs from dark green to black where any thickness remains on the electrode. When welding, the voltage at the machine should be between 42 and 48, with the voltage across the arc itself between 22 and 28. The amperage taken at the arc should be 285.

One of the reclamation problems that has long confused foundry engineers is that of reclaiming used core sand. However, after much experimentation by engineers of the Link-Belt Co. and the Wright Aeronautical Corp., a method has been developed by which such core sand can be efficiently and economically reclaimed (this method described in issue of Dec. 17, THE IRON AGE). As this process requires the use of heat to remove the binder it has been called the "thermal" method. The first installation of this new method was at one of the plants of the Wright Aeronautical Corp. and was used to reclaim core sand resulting from casting aluminum aircraft parts.

The success of this unit has resulted in this aircraft company undertaking the installation of several additional units, including one at a new magnesium foundry. A number of other plants are also planning similar installations. The term core sand when used in connection with the Wright installation has reference to the dry sand mold used there for casting aluminum aircraft parts. The characteristics of this material are quite similar to the average internal core.

The Wright reclamation unit consists of equipment which crushes the cores, removes gaggers, core rods, etc., then further granulates the lumps, classifies them and passes them through a kiln where a temperature of between 1400 and 1500 deg. F. is maintained. This heat removes carbon and other organic material. The burnt sand is then carried to a cooling unit, past a dust collector which serves to further classify the sand and deposits it into bins, ready for reuse. This unit is capable of handling between 4 and 5 tons an hour, but units with much larger capacities are under construction.

The efficiency of this reclaiming unit is attested by the fact that the reclaimed sand is used at the Wright plant for all purposes that new sand is normally used, except for core blowing. Backing sand, for instance, is made of 100 per cent reclaimed material and in making facing the reclaimed sand is used in the same proportions as is new material, except that about 1 per cent more cereal binder is required.

The amount of carbon remaining in the sand after passing through this unit is about 0.5 per cent, according to ignition tests. The sand is so thoroughly cleaned that with a small magnification it is possible to differentiate between round Wedron grains and angular Penn Glass sands in samples taken at the discharge end of the unit.

With recirculation of material thrown off the coarse side of one of the classifiers, it is possible to reclaim 85 per cent of the sand going into the unit. There is some loss in fines and dust and some sand remains adhered to the core wire and gaggers. At the present, there does not seem to be any limitation on the number of times a sand may be put through the system, provided the temperature in the kiln is not permitted to reach the point where cracking or fusion of the grains take place.

Aside from operating economies and the value of any reclamation effort under today's conditions, this core sand reclamation frees a large number of freight cars for other purposes and assures a steady supply of the proper type sand.

British foundries, forced to import a large share of their special sand requirements, have been faced with the task of finding a substitute for bentonite used for magnesium alloy casting. The chief substitute at present appears to be a proprietary product based on fullers' earth, similar in mineralogical constitution to bentonite, according to a report by F. A. Fox of Magnesium Elektron (*Foundry Trade Journal*, p. 69, Jan. 29, 1942).

A 144 lb. mix of synthetic silica sand, bonded with 4 per cent fullers' earth was made and it was tested for a comparison with a bentonite

PERFORMANCE

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THE BRAD FOOTE PLANT with its wide scope of gear making operations covering every type and ratio of gear and speed reducer manufacture, can serve you most efficiently when you are designing special machinery.

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bonded mixture. These tests showed the following results:

	Fullers Earth Bonded	Bentonite Bonded
Moisture, per cent.....	2.75	3.2
Compression, lb. per sq. in..	6.1	5.0
Permeability, AFA units.....	125.0	100.0

These results were interpreted as showing a satisfactory combination of strength and permeability for the fullers' earth mixture.

Two box-type test castings were also made with the fullers' earth mix. These turned out very satisfactorily, with all fins perfectly run, an accomplishment which was termed unusual with bentonite mixes. This was felt to be due to the higher permeability of the fullers' earth mix.

The fullers' earth mix was used continuously for over two months, being milled about 40 times. At the end of that period the sand had the following characteristics: Moisture, 3.3 per cent; compression, 8.8 lb. per sq. in., and permeability of 101.

The fullers' earth mix was used on a number of routine jobs and was found to be quite satisfactory and its behavior did not differ materially from that of bentonite.

It has been said that the surest way to start an argument when two foundrymen meet is for one to express an opinion on gating or risering practice. Yet, withall, there is probably less science involved in the average foundryman's attack on a gating problem than on any other phase of casting production. With this background, it can be readily understood why so much interest was evidenced in the new technique in gating and risering reported by Rominski and Taylor of the Naval Research Laboratory at Anacostia (in a paper entitled "Atmospheric Pressure and the Steel Casting," presented at the May convention of American Foundrymen's Association; reported in THE IRON AGE, April 30, 1942, p. 57).

The paper is based on tests of a method, originally developed and patented by the Dodge Steel Co., which takes advantage of atmospheric pressure when using blind risers. Rominski's and Taylor's work confirmed the Dodge company's experience that the most important factor in the use of blind risering is that of keeping the riser open so that atmospheric pressure may work upon the liquid metal in the riser.

The method employed successfully by Dodge on a large variety of castings consists of imbedding a round dried sand core in the sand at the top of the riser so that it extends into it for a distance roughly equal to the radius of the riser (see Fig. 3). This core is a simple rod core of a type found in the average foundry, except that a small vent hole extends through the center. This vent hole, the authors said, was not absolutely necessary but is recommended. The important point is that the core be sufficiently strong and refractory to withstand the pressure and temperature of the molten metal and permeable enough to allow passage of gases.

This core breaks the seal which otherwise would form completely over the riser by extending into the center of the riser where there is still liquid metal. This permits atmospheric pressure, acting through the permeable core, to force the metal from the riser into the partial vacuum tending to form within the casting proper.

Abrasives are playing a most important part in delivering the materials needed to bring final Victory to the Allied Nations. Although the service they render is not spectacular, it nevertheless makes possible the delivery of guns, planes, and tanks faster and in larger volume than if metal were finished by less efficient methods.

LIONITE is helping many companies to increase and maintain from 25 to 50% more production in their polishing departments than when ordinary abrasive grains were used. NB Lionite works especially well with cements. Its polyhedral shaped grains are free from unproductive flats and slivers. Their tough, sharp cutting points cut fast and wear down slowly.

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As never before, with ever-increasing skill, our craftsmen are producing tough steel tendons for fighting machines. Before there can be war machines, however, ores, oil, coal and stone must be mined. Steel and metals must be made, lumber logged, war plants constructed and fitted. Then there must be highways, seaports and airports hewn out of the earth around the globe.

Think! Try to imagine what a limitless, hopeless, man-killing job it would be without modern wire rope to do the digging, shoveling, hoisting and countless other burdensome tasks. Then resolve to use your wire rope with great care.

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"THE ULTIMATE LOW COST WIRE ROPE"

Detroit, The Phenix

(CONTINUED FROM PAGE 158)

are naturally a military secret but it can be said that 1942 truck output was definitely in lower ground than in 1941, when civilian demand spurted to its highest in history. The objective of 1942 output of trucks was to build an Army inventory—basis was laid for complete mechanization. During 1943, ahead, the primary objective will be the replacement of truck units knocked out in battle and the equipping of new divisions being formed out of the increase in manpower in the Army. However, rapid this increase will be, and it will be rapid, it will not make necessary the delivery of as many trucks during the forthcoming 12 months as were delivered to the Army during 1942 — particularly since a wartime Army does not move with the same standards of luxury as does a peacetime Army such as was earmarked in 1941 for one truck for every five fighting soldiers.

Gun production during 1943 by the auto industry is unlikely to be as large as it was in 1942. The fact is that the industry was engaged mainly in the output of anti-aircraft and machine guns. In the first instance, anti-aircraft guns, actual demand from Army buyers has fallen off—as we entered the offensive phase of the war toward the end of 1942, the need for defensive weapons such as anti-aircraft guns quite naturally diminished. In the second case, machine guns, the simple fact is that output during 1942 in the automotive plants which built most of these rapid fire units was so far above expectations that considerable inventories have been built up in Army warehouses. There simply is a lighter need and demand for machine guns than would have been the case if the production record for the immediate past had not been as bright.

The same might be said for shell and ammunition production. Output of these essentials of war has been so far above expectations, not only in the automotive plants but in others as well, that depots of the Ordnance Department are bulging today. As a result, such contracts were importantly reduced at the end of 1942.

It would be in no way surprising to see a considerable increase during 1943 in automotive industry contracts for manufacture of ship sections, ship turbines and ship engines. In the first place, demand for all sorts of marine craft is being considerably amplified along with demand for aircraft parts, both for cargo carrying purposes and for invasion purposes. In the second place, the slackening of tank schedules in the establishments of the major producers leaves open a considerable amount of production equipment which is well adapted to the manufacture of heavy engines and heavy metal sections. The same foundries and the same welding shops which turn out tank sections today can well be making ship sections tomorrow. The same engine facilities which are powering tanks right now may be usable equally well tomorrow for the manufacture of heavy marine motors.

More certain marine increases will be reflected in enlarged schedules for gasoline power plants for

FASTER! FASTER! Speed is indispensable to victory. If you can't get your small parts *when* you need them or the *way* you want them, send us your specifications. Special nails, rivets and screws in any metal. Catalog on request.

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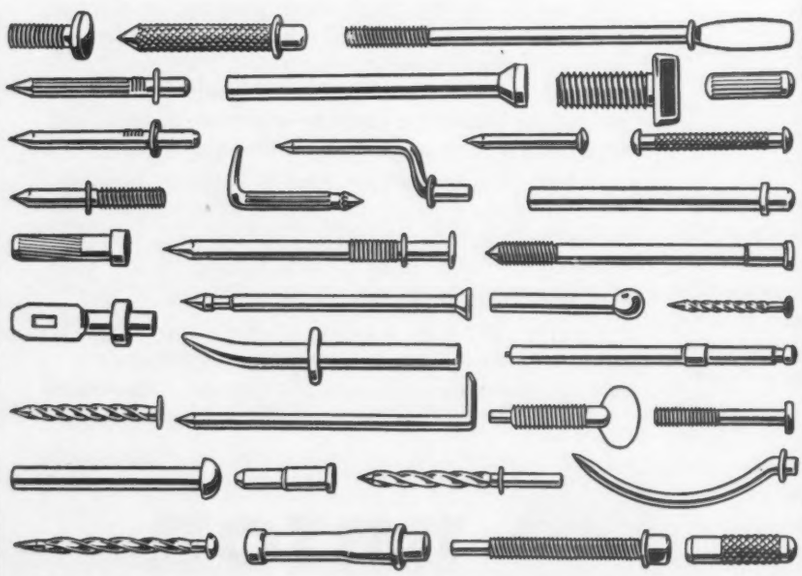

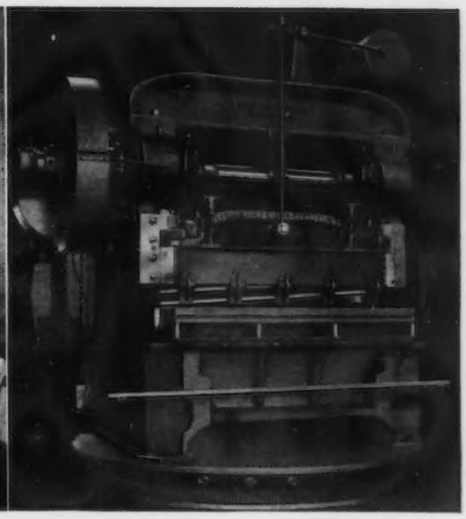

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When you present any heavy metal working problem to BEATTY for solution, you enlist:

1. First rate engineering minds.
2. Wide experience in solving production problems closely related to your own.
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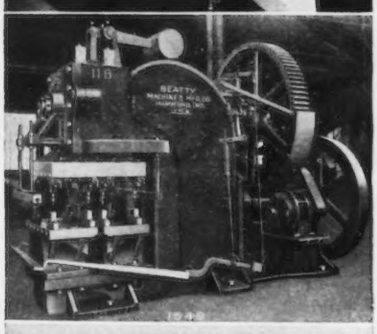
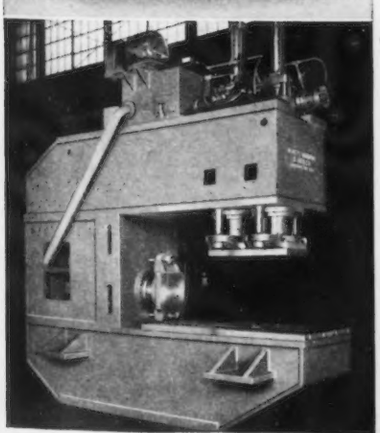
You'll find BEATTY designed and built equipment serving important shipyards, railroad shops, aircraft plants and other units in the heavy metal fabricating field. Do YOU have a production problem we might help solve?



BUILDERS OF HEAVY METAL WORKING TOOLS



Shown at left: The Beatty No. 11 Heavy Duty Punch and the new Hydraulic Flanging Press. These are two items in our complete line of heavy duty punches, shears, coping machines, forcing presses, extruding presses, forming presses, and bulldozers — all designed and built by Beatty engineers for the ship, tank, aircraft, truck, railroad and other heavy metal fabricating industries.

BEATTY MACHINE AND MANUFACTURING CO.
Hammond, Indiana

torpedo boats, and diesel power plants for submarines, small surface craft and auxiliary craft.

The volume of combat cars and anti-tank weapon cars can be expected to gain. The jeep, conceived by American Bantam and built with distinction by Willys and Ford as well, has successfully met its acid tests on various battlefronts throughout the world. Its continued sustained output is expected. At the same time, there is coming into being a vast number of varied types of anti-tank weapon carriers, known loosely as "tank destroyers" —ranging all the way from heavily armored and track-moved multi-ton units down to comparatively light scout cars carrying comparatively small armament.

One of the big achievements of 1942 which will be carried forward into 1943 is the improved production technique apparent all down the line in the automobile plants. It is doubtful whether any year before 1942 saw as many changes in technique devised with a view to increasing production, saving critical materials, cutting production time, and turning out a more satisfactory product.

Forgings which were machined down to half their original weight before they became finished products have now been superseded by improved means of manufacture, which reduce scrap waste from 10 to 95 per cent. Machines have been devised which took orthodox ways of doing things a year ago and revamped them so that production time requirements which were measured in terms of hours twelve months ago have now been cut down to minutes. Throughout the automotive industry, employees have been enlisted in suggestion drives which yielded ideas numbered in the thousands, devised primarily to speed the winning of the war but translatable during 1943 and beyond into improved techniques of operation.

By way of epitomizing the results of this technique-improvement drive, the experience in the manufacture of a certain type of shell can be described. The original going price to the government a year ago on this shell was $16.28. Production underwent a series of changes. As a result the delivered price to the government, having gone through several contract revisions, is now only slightly over $9.00 per unit, and a reasonable profit is still being made for the company which is selling at that low price. Obviously, price cutting of such a sort is possible only when manufacturing time is vastly reduced.

No record of the year, 1942, would be complete without tribute being paid to the Automotive Council for War Production. This organization was set up after Pearl Harbor, with the intent of pooling the "know-how" of the automobile industry and its suppliers in one great effort to win the war. Not only has "know-how" been pooled, but production facilities have been exchanged, information has been freely disseminated from maker to maker, the unified industry viewpoint has been made known and has been effective in many situations where industry needed a lucid voice, and progress has thereby been speeded.

This council has been the prototype for two aircraft company councils formed on the East and the West coasts.

EASY-FLO

SAVED VALUABLE METAL

FREED SCREW MACHINES FOR OTHER WORK

TRIPLED PRODUCTION

.on this war job

Fuse seat liners for bombs formerly were made by turning down heavy tubing. This tied up screw machines, consumed power and wasted a lot of valuable metal.

Now the job is done as illustrated at the left. A steel collar is low-temperature brazed to a piece of steel tubing of the desired diameter and wall thickness. Machine time, power and metal are saved and sound Easy-Flo joints give the new type fuse seat liners the strength of solid metal.

That Easy-Flo gave a big increase in production, 300% in this case, is not unusual. It does show, however, that a simple change in design can often conserve time, metal and machines. It explains, too, why Easy-Flo is specified and widely used in the making of planes, ships, tanks, guns, shells and a long list of other war products.

FIND OUT HOW EASY IT IS TO PUT EASY-FLO TO WORK IN YOUR PLANT

Bulletin No. 12 will tell you. Also give you full details about Easy-Flo, including the reasons for its speed and reliability in making strong, leak-tight, permanently sound joints. Useful information about joint designs, heating methods, production procedures, etc. is also included. A copy of Bulletin 12 will be mailed on request. Write for it now.

EASY-FLO MAY HELP YOU SPEED UP FOR VICTORY

Check your metal-joining operations for similar opportunities to save machine time and materials and speed up production by changing to Easy-Flo brazing. We'll be glad to work with you in determining what Easy-Flo can do for you.

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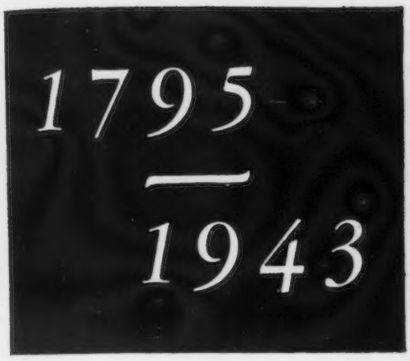
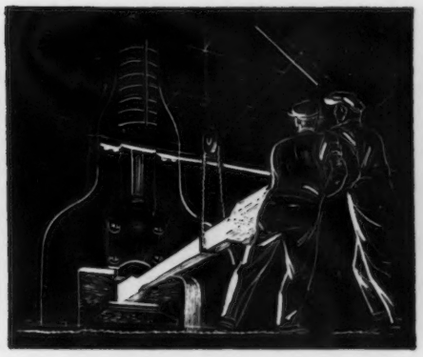
75th ANNIVERSARY

ARMY E NAVY

Resolved—

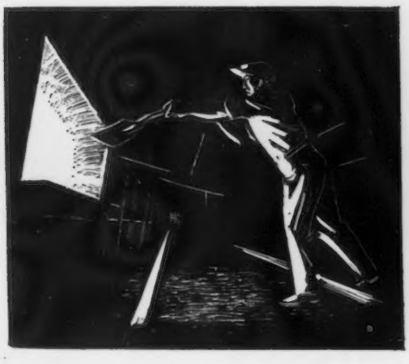


that, to 147 years of Standard history shall be added another year of service to America, to its railroads, and its industries.



that, the skill and long experience of Standard personnel shall be constantly applied in the production of every Standard product.

that, from acid open hearth to finished forging, Standard process control shall protect Standard quality at all times.



that, the constant supervision of materials by Standard's trained metallurgists shall continue to safeguard customer's interests.

that, the reputation for dependability and long service enjoyed by Standard products through the years be increasingly deserved.

that, the high production for war which merited Standard workers the Army-Navy E and subsequent added stars shall be steadily maintained.

that, above all, the energy and resources of all of us at Standard shall be devoted unselfishly in support of the more than two hundred Standard employees now in our country's armed forces, and toward hastening the day of homecoming for them and all of America's sons.

STANDARD STEEL WORKS

DIVISION OF THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

Shipbuilding, Aircraft and Women

(CONTINUED FROM PAGE 159)

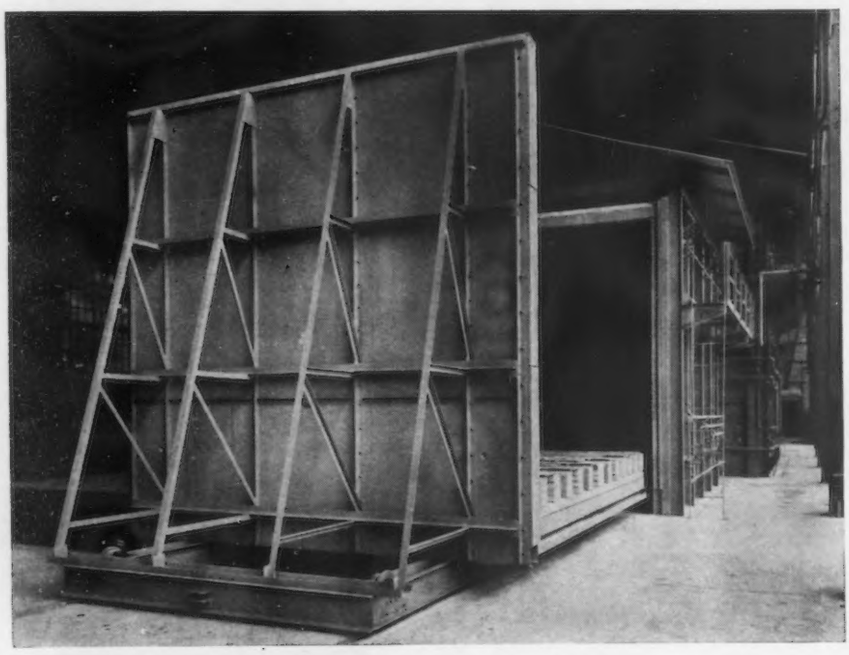
sly stories all make good recreational reading, but the account of how women have overcome their dislike for noise, dirt, sweat and hard manual labor is also the story of how Coast aircraft plants, after faltering, were able to approach their production goals for 1942. It also is an important chapter in the saga of record ship launchings.

During 1943, much of the industrial success of the region west of the Rockies will depend upon its ability to recruit and train women workers—ultimate monthly production goals are still far away, and there is no large labor pool left other than women, and possibly a substantial number of workers from trade and commerce.

A year ago the Coast did not know whether it had an industrial future. Following declaration of war talk was serious of cutting short the spectacular industrial life of the region, moving all vital factories east of the Rockies, and letting the area sink back into its old economy, based on agriculture, lumbering and mining. Indeed, some aircraft factories actually were ordered to place no more sub-contracts west of the Rockies. But it shortly became clear that the aircraft and shipbuilding industries already were too deeply rooted to be easily transplanted, even though they were located on the front line, and the entire West officially designated a combat zone. Anti-aircraft guns were clustered at strategic points, some tightening of plant protection was ordered and the boys went back to work.

Production of aircraft began its long, gradual gain, although it never has reached the point where the planes "roll off the assembly line" as the caption writers like to believe. The new merchant shipyards, even younger than the aircraft plants, made more spectacular production records during the year, in which they took both the spotlight and the labor force away from the plane factories which had held it in 1941.

The shortage of materials hit the Coast while the rest of the country was still making steel gadgets. Coast shipyards were the first to feel the pinch in plates. And when the rest of the country took up the hue and cry for plates, hulls clustered outfitting docks waiting for deliveries of valves and small fittings. Months after Pearl Harbor, as many as 100 military planes stood at a southern California aircraft plant, complete except for propellers or small engine parts. Possibly because it is so distant from many sources of supply, the Coast throughout 1942 has felt the unbalance caused by delivery of last parts first and first parts last more than any other section. And because of this distance, too, inability to fill emergency needs has caused serious delays. Most of these difficulties were ironed out by summertime though and it then became apparent, as the impact of the tremendous production schedules hit home, that the real basic problem of this region, late of the wilderness, but now holding more war



VULCAN ANNEALING, NORMALIZING AND HEAT TREATING FURNACE...

With Improved Firing and Control Features

A new method of direct firing, in the Vulcan Car Hearth Furnace illustrated above, produces a convection effect and provides greater efficiency and economy in the heat treatment of castings and weldments. Advantages: Less time to uniformly heat the charge to temperature; better uniformity at temperature; more rapid, uniform rates of heating, even when charge is not uniformly loaded in furnace; elimination of localized high temperature areas, thus reducing furnace maintenance and lengthening furnace life. Oil or gas fired, with several zones of control.

Send for complete information about this and other Vulcan custom-built furnaces for Annealing, Normalizing, Stress Relieving and other Heat Treating Operations; Forging, Melting and Special Heating work.

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Industrial Engineers

SALEM ENGINEERING COMPANY

All Types of Heating Equipment and Allied Mechanisms

Aluminum Billet Heating Furnace

THE combined production from all Salem aluminum billet heating furnaces exceeds that of any other make. Broad experience and knowledge gained through the development of all this equipment won for Salem high recognition — especially since these Salem furnaces heat billets with the greatest uniformity at less cost and in the minimum of time.

The furnace, illustrated above, heats aluminum billets prior to rolling, using oil-fired convection units which bring the billets from room temperature to 1000° F. at a rate of 3600 pounds per hour. The billets, with diameters ranging from 6" to 10", vary in length from 12" to 28". The moving hearth consists of 6 strands of chains with special attachments for holding the round billets. Each two strands of chains constitutes a separate conveyor which has its own drive at each end of the furnace, thus permitting operators to reverse the travel. There's no guesswork when Salem's aluminum billet heating furnaces are being built, and hence production starts off immediately without days and weeks of delay for final adjustments. You get more production with less maintenance.

Consult Salem engineers now regarding your furnace problem, whether it's for ferrous or nonferrous metals.

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contracts along its shores than any other part of the nation, is MANPOWER.

Labor Shortage Acute

The term "manpower" is no mere abstraction to the Pacific Coast, for there labor shortage has reached the point where it not only throttles plans for industrial expansions which might be made, but actually makes impossible optimum use of existing facilities. When a pot line was cut from the original plans for a Pacific Northwest aluminum plant because insufficient workers were available to man the portion of the plan already constructed, it was a signal of danger affecting that entire region, where power, natural resources, and other production elements are readily obtainable. But far more serious was the ironic case of a large western ordnance plant which was forced to close its doors several days a week because of shortages of copper and zinc, which shortages came about when the copper and zinc mines were unable to meet production schedules because so many employees had left to go to work in the higher paying ordance plant involved.

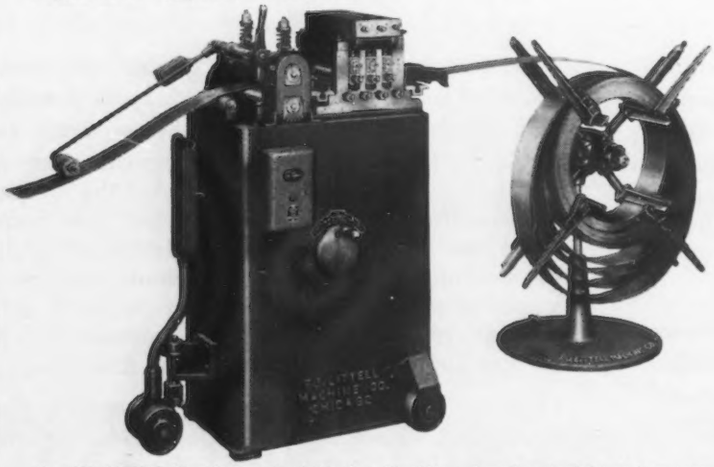
Throughout the region, the repercussions of building in three or four years' time a gigantic, geographically concentrated industrial empire on a tiny industrial base are apparent. Not only are the principal industries affected, but ripples radiate through the entire economic fabric. In Los Angeles county in January, 1939, 13,300 workers toiled in the aircraft industry; by Pearl Harbor there were 118,000. Current figures are not now available, of course, but the betting fraternity would regard it as a sound even money wager that the latter figure for a year ago will have doubled by the time this appears in print. Possibly a third as many workers build ships in Los Angeles county as work in the airframe and accessory plants. According to the California State Department of Industrial Relations, there were 377,000 manufacturing wage earners in the Los Angeles industrial area in October, the latest month for which figures are available. In other words, if you should go to Los Angeles today, it would be safe to assume that every other factory worker you met was employed in the aircraft industry and that three out of four worked either in plane or shipbuilding plants. In the San Francisco Bay area, which has no aircraft plants, the shipbuilding industry has by no means reached its full growth; yet easily three out of four of the men dressed in work clothes are employed in the shipyards. Official State figures for October show that wage earner employment in manufacturing, which includes the shipyards, in the San Francisco Bay industrial area stood at 223,000. Even though official figures are closely guarded, you don't need a statistician to know this area has gone to war. Ratios are even more lop-sided in the Seattle, Tacoma, Portland, and San Diego areas which had still less factory employment than the two larger California cities at the outbreak of the war. From August, 1941, to August, 1942, alone, employment in Tacoma jumped 120 per cent, U. S. Department of Commerce figures show. Is it any wonder that the

(CONTINUED ON PAGE 294)

Victory Over Production Delays with LITTELL PRESS-ROOM EQUIPMENT

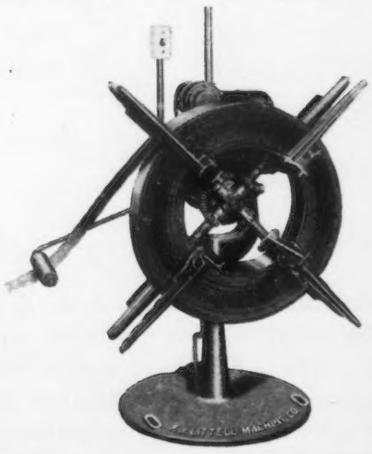
KEEP your plant schedules going steadily—insure rapid production and efficient operation from every machine. Install LITTELL Press-Room Equipment. Compact. Simple in design. Ruggedly built. Maintains output at maximum speed. Hundreds of plants are LITTELL equipped.

LITTELL makes a most complete line of Feeds, Reels, Straightening Machines, Scrap Cutters, Air-Blast Valves, Safety Pres-Vac Feeders and Mechanical Pickers—in suitable combination to meet any plant production requirement. REQUEST BULLETINS.



No. 308 LITTELL Continuous Straightening Machine. Supplies straightened material to automatic punch presses. Handles material up to 8" wide. Speed, 10 to 67 feet per minute, using ¾ h.p. motor. Number and size of straightener rolls used depends on thickness of material. Littell Reel shown is 300 lbs. capacity.

Littell Automatic Centering Reel for Unreeling Coil Stock



No. 3-G Littell Patented Motor-Driven Automatic Centering Reel and Scrap Winder. This unit can be used for unreeling materials or for winding scrap by simply changing direction of motor. Coil capacity, 300 lbs. Will take coils maximum width 6½", maximum O. D. 48", I. D. 8½" to 21". Shipping weight, 300 lbs.

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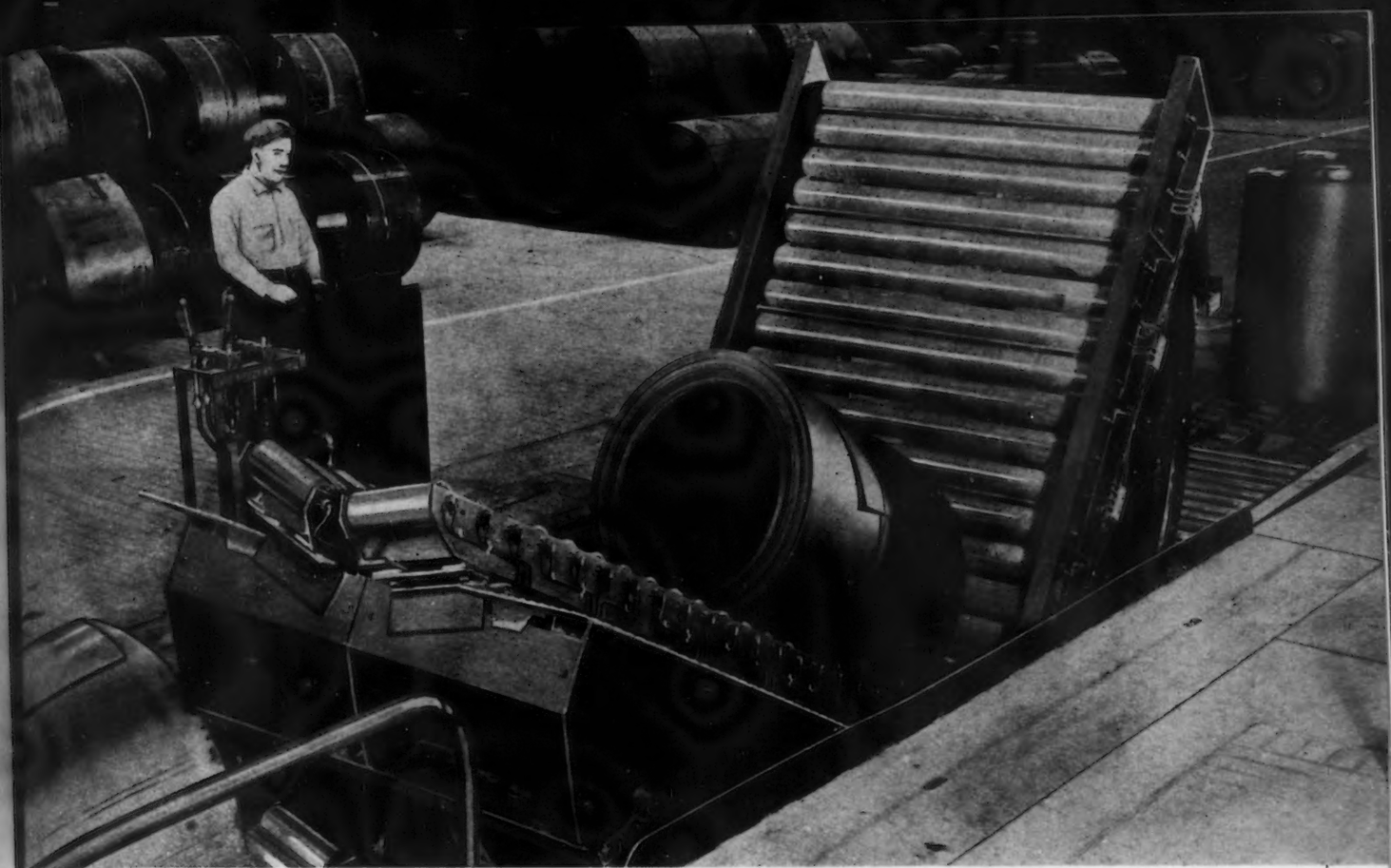

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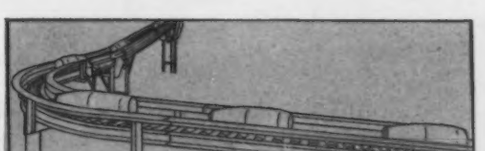
The success of the Allied war effort depends greatly upon the speed of our production — the output of coils and sheets, castings and forgings, bars and shapes — and thousands of other vital materials. American Industry has already come through in a way that spells disaster for the Axis nations, and it's only the beginning.

Mathews Engineers are spending long hours in solving the many conveying problems which go along with this great production program. You can get Mathews engineering service and Mathews Conveyers with much less delay than you might think. By furnishing the highest preference rating you can possibly obtain, along with complete information regarding your problem, much time can be saved in obtaining the conveying equipment you require. Our job is to serve you in the most efficient manner possible.

MATHEWS CONVEYER CO.

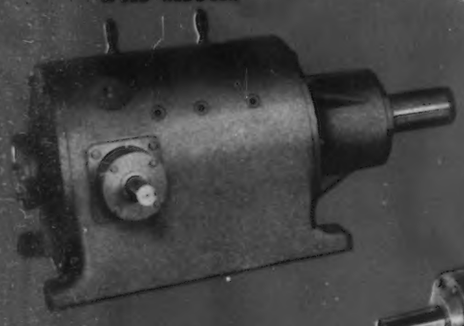
ELLWOOD CITY, PENNSYLVANIA



If you are manufacturing war material, or anything vital to the success of the war effort, you can get Mathews Conveyers to handle that material Rely as usual on your Mathews Engineer.

MATHEWS CONVEYERS FOR MECHANIZED PRODUCTION

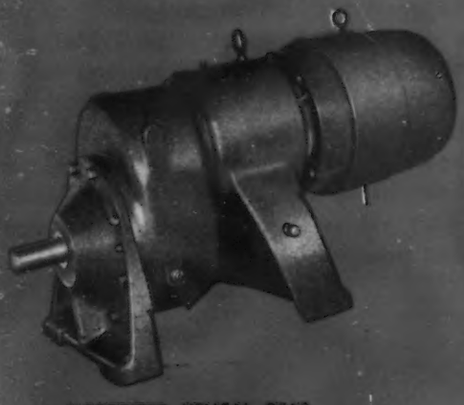
RIGHT ANGLE PLANETARY GEAR SPEED REDUCER



DOUBLE REDUCTION CONTINUOUS-TOOTH HERRINGBONE GEAR SPEED REDUCER
Straight Line Drive

MOTORIZED PLANETARY GEAR SPEED REDUCER
Horizontal and Vertical Types

D.O.James SPEED REDUCERS



MOTORIZED HELICAL GEAR
Horizontal and Vertical Types

HEAVY DUTY WORM GEAR SPEED REDUCER
Type H—Horizontal Type

DOUBLE WORM GEAR SPEED REDUCER
Shaft Extended Upward

MOTORIZED WORM GEAR SPEED REDUCER
Horizontal Type

FOR OVER A HALF CENTURY MAKERS OF

RIGHT ANGLE SPIRAL BEVEL PLANETARY GEAR SPEED REDUCER
Vertical Type

DOUBLE WORM GEAR
SPEED REDUCER
Horizontal Type

PLANETARY GEAR
SPEED REDUCER

RIGHT ANGLE SPIRAL BEVEL
HERRINGBONE SPEED REDUCER

HELICAL WORM GEAR
SPEED REDUCER
Vertical Type

THEY JUST KEEP ROLLIN' ALONG

Established 1888

The precision-in-built quality and design of the D. O. James Speed Reducers gives them a formidable achievement record that has definitely proven the statement that they are "built to take it." Now, more than ever, this is an imperative quality—and will vitally aid in the maintenance of American Industry's War-Time Production Schedules —"*That Must Be Kept Rollin' Along!*"

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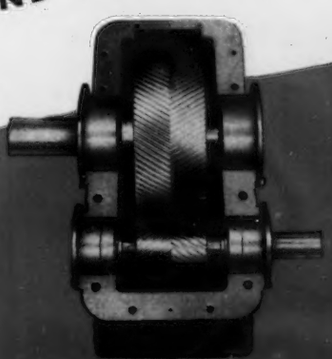
HELICAL WORM GEAR
SPEED REDUCER
Horizontal Type

EVERY TYPE OF GEAR AND GEAR REDUCER

MOTORIZED WORM GEAR
SPEED REDUCER
Vertical Type



CONTINUOUS-TOOTH
HERRINGBONE GEAR
SPEED REDUCER
Single Reduction

TRIPLE REDUCTION
CONTINUOUS-TOOTH
HERRINGBONE GEAR
SPEED REDUCER

Air Warfare Comes of Age

(CONTINUED FROM PAGE 223)

able, speedy, and has a fast rate of climb — but for these qualities battle qualities were sacrificed. Until American flyers in Curtis P-40's and Bell P-39's learned how to fight these ships, they took a licking, but as soon as a technique was discovered that worked, the "Zero's" no longer remained the terrors of the Oriental skies. OWI score sheets will verify the fact that the "Zero" is not a superplane.

Russian Aircraft

One and only one country in the war offered a surprise with its aircraft, both to its allies and to the enemy, and that was Russia. Russian planes that put in an appearance at the war previews in Finland and Spain were considered by aviation experts as nothing more than crates and flying boxcars, but those that showed up against Germany gave Herr Goering and his cohorts the surprise of their lives. Instead of being made up of prototype ships, as was generally believed, the Russian air force was supplied with ships that ranked with the best in the skies. The Stormovik IL-2, a divebomber used primarily in low flying ground force attacks, raised havoc with the German tank forces; while the YAK-4 variations of bombers have also been highly successful. The PE-2, a new attractive, high speed bomber, has also taken an active part in the defense of Russia.

At the present time, Russia has at least four modern fighters of its own design in the air: The I-18, the I-19 or I-21, the I-20 and the I-26. The I-18 is a new design, known as the "Red Spitfire" or the MIG-1 "Mickie." Carrying eight guns in its wings, this ship was originally credited with a speed of over 370 m.p.h. with a range of 650 miles. The I-19, derived from the prototype I-17, has a speed of 330 m.p.h., a range of 560 miles, and uses six wing machine guns. The I-21 is a modified I-19. The I-20, a single seated fighter, also known as the MIG-3, resembles the I-16 and I-19. It has a speed of 340 m.p.h. with a range of 620 miles using six wing machine guns. The I-26, a new Russian ship, also is known as the JAK-1, indicating that Alexander Jakovleff, present holder of the Stalin prize, designed it. Its speed is about 360 m.p.h. over a range of 685 miles, and it carries eight wing guns of varying calibres. Other fine Russian ships are: The SB-3, a two-engine bomber, and the ANY, a four-engine bomber with 12-cylinder, 1000-hp. in-line engines. Consequently, the original tendency of all and sundry to sell Russian airpower short has left some pretty red faces.

On the whole, however, the United Nations have one distinct advantage in the aircraft picture over Germany and Japan, and that is the bulk of the world's available materials to build finer and more substantial planes. There is no monopoly of brains on the side of the United Nations and Germany is a

THE BRIDGE FROM RAW POWER TO MACHINES

The "bridge" which transmits raw power to the requirements of your machines is leather belting. Obviously, therefore, leather belting is *important*. For, on it depends your production.

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formidable opponent on this score. Some German ships are better than par in engineering and design excellence, and are superb in performance. Many new developments can be traced directly to German engineering skill. However, the "know how" of mass production and the greater reserves of raw materials to built better fighting craft are on the side of the United Nations. These are the advantages that must be pressed.

In examining what has been done from an engineering and production standpoint by American aircraft builders, engine builders, parts suppliers, and other associated industries, while much of such information is censorable, it is easily seen that developments are far too numerous to classify. For example, Consolidated Aircraft Co. alone made 200 design changes in the B-24 bomber last year. One of the most far-reaching developments of the past year was the design of a new, liquid-cooled engine by the Lycoming Engine division of Aviation Corp. The new engine, believed to be the first liquid-cooled power plant to be adopted by the Navy, will have a horsepower rating well above any other engine of its type now in production and will compare favorably with the power of the largest air-cooled aircraft engine now in production. This would indicate that it is at least a 2000-hp. motor. To build this motor, a new plant that is completed and partially tooled was built at Toledo, and will be operated by a new organization, the Liquid Cooled Engine division of Aviation Corp.

New Fighter Ship

To utilize fully the features and advantages of this power plant, an aircraft builder on the West Coast, believed to be Vultee Aircraft Co., is designing an entirely new ship, from the ground up. This ship will be a fighter type but is expected to be larger, faster, and more heavily armed than any now in action. Completion of the ship design is expected to coincide with completion of the engine plant, where production is expected to start in the early spring.

Also at Toledo was put into production last May the first plant designed exclusively for mass production of propeller blades by the unique method of processing them out of seamless steel tubing. American Propeller Corp., subsidiary of Aviation Corp., is at present producing more than 2500 of these blades a month and production has not yet reached its peak. These blades are being used on Army bombers, one of which is the Martin B-26. The manufacturing process consists of a series of forging and cold pressing operations to shape the blade, machining, and the feather end of the blade is welded. The blade in its process stages is shown in Fig. 5.

These blades, because they are hollow, are lighter than aluminum blades in the larger sizes. Being of special chromium-molybdenum alloy steel, they have high resistance to corrosion and abrasion, good physical properties, and elevated fatigue limits.

The increasing demands for airplane propellers has placed a heavy burden on what, in peacetime, was not a particularly large industry. In addition to expanding production facilities, production short-cuts

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Cincinnati, Ohio.....Williams & Co., Inc.
Cleveland, Ohio.....Williams & Co., Inc.
Columbus, Ohio.....Williams & Co., Inc.
Detroit, Michigan....C. E. Philips & Co., Inc.
Erie, Penna.....Boyd Welding Co.
Fresno, Calif.....Victor Equipment Co.
Ft. Wayne, Ind..Wayne Welding Sup. Co., Inc.
Honolulu, Hawaii.Hawaiian Gas Products, Ltd.
Houston, Texas..Champion Rivet Co. of Texas
Kansas City, Mo..Welders Supply & Repair Co.
Kingsport, Tenn.....Slip-Not Belting Corp
Los Angeles, Calif.....Victor Equipment Co
Milwaukee, Wis....Machinery & Welder Corp
Moline, Ill.....Machinery & Welder Corp.
New York, N. Y.....H. Boker & Co., Inc.
Oklahoma City, Okla.. Hart Industrial Supply Co.
Pampa, Texas.....Hart Industrial Supply Co.
Pittsburgh, Pa.....Williams & Co., Inc.
Rochester, N. Y.....Welding Supply Co.
San Francisco, Calif....Victor Equipment Co.
Seattle, Wash.....Victor Equipment Co.
St. Louis, Mo.....Machinery & Welder Corp.
Syracuse, N. Y.....Welding Supply Co.
Wichita, Kansas.....Watkins, Inc.

had to be found. Hamilton Standard Propellers division of United Aircraft Corp. was a leader in this regard. As machine tools were in heavy demand throughout the country, Hamilton engineers adapted operations in propeller manufacture to machines on which reasonable delivery could be obtained and endeavored to make machines on hand increase their output.

For example, a Morton keyseater was substituted for a Pratt & Whitney vertical shaper with a rotary table to generate a hex into the piston that serves as a combination piston and propeller retaining nut on all controllable pitch propellers. The keyseater was converted into an automatic machine for this purpose by the construction of special fixtures. A Geneva motion with a cam arrangement was used, the feed mechanism being obtained from the cam and the divisions from the Geneva motion. This operation simplification not only increased production some 40 per cent, but eliminated the need of a skilled operator, conserved floor space, and provided an 80 per cent saving in labor.

Small U-shaped spring pack retainers that hold the springs which provide the drive between gear segment and propeller blade for changing pitch are used in large quantities, 16 to a blade. They are in effect shock absorbers for this drive mechanism. Originally, a specially formed extruded bar stock was used. It was milled out through the center, broached, parted to the proper size, and then ground on the outer surfaces to close tolerances.

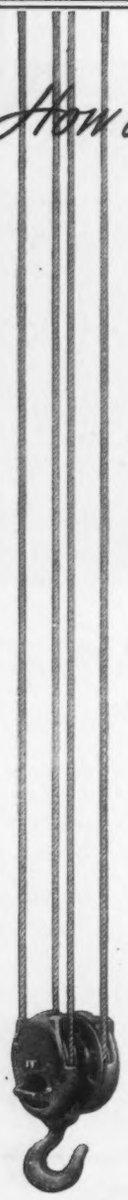
A self-fed LaPointe broach, fed with standard rectangular barstock, was substituted for these operations. The stock is fed through a trough into the machine by a hydraulic floating clamp which eliminates distortion of the barstock and friction in the feed mechanism. Instead of milling out the center of the stock, three slotting broaches cut in from the side to an accurate tolerance and thus three individual pieces are slotted at one stroke.

The bar then automatically feeds to the next position with special index features assuring proper alinement. The second operation is the forming of the three radii on the opposite side of the bar from the side which has been slotted. This is done by a special forming broach, and the bar feeds to the next position and the piece is indexed.

The third operation is the parting of the first three units, those which have been slotted and on which radii have been formed. Hack saws operating as broaches accomplish this work. When the machine is in operation and the barstock has started to feed, all three operations are performed simultaneously and at each stroke of the machine three complete units are ejected. Through the use of this specially tooled LaPointe broach, the cost per unit has been reduced 75 per cent.

Plastics In Aircraft

Another phase of aircraft production that has undergone an about-face in acceptance has been the substitution of such materials as plastic-bonded plywood and carbon steel for aluminum and alloy



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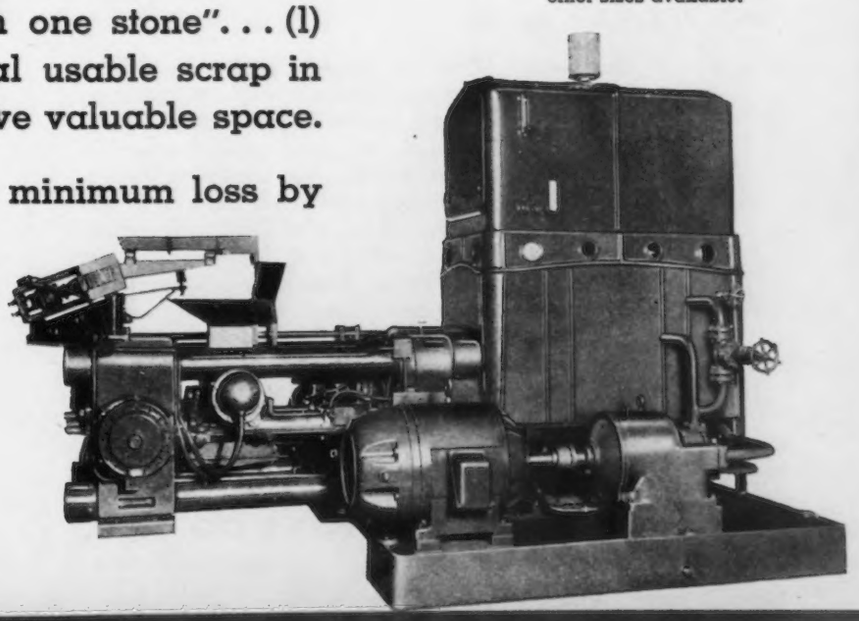

MILWAUKEE FOUNDRY EQUIPMENT CO.

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steels. In number, the manufacturers of plastic-bonded plywood airframes and aircraft parts are increasing surprisingly fast. In Los Angeles County, Cal., alone, there were some 119 firms engaged in this work. Timm Aircraft Corp., a large fabricator of sub-assemblies for big aircraft companies, has pioneered in this field and expanded its operations in this field late in the year. Ryan Aeronautical Co. introduced a new military trainer, shown in Figs. 6 and 7, for the Army of plastic-bonded plywood construction, eliminating the use of aluminum alloys and all strategic materials in the fuselage and wing construction. The only use of critical materials in the fuselage and wing design was in the engine cowling, which represents less than 2 per cent of the total weight of the plane. Likewise, plastic-bonded plywood is being used in the bomb-bay door of the Martin B-26 bomber.

The Army indicated in June that the greater portion of the advanced, basic, and primary trainers would be of plywood construction. The North American AT-6, an advanced trainer, made use of a combination of low alloy, low carbon steel and plywood in a new construction design, reducing aluminum requirements by 75 per cent (THE IRON AGE, April 2, 1942, p. 68A, and July 2, 1942, p. 62). By combining thin gage auto body stock with an expanded sheet metal mesh backing, Vultee Aircraft, Inc., designed a fuselage panel as light as aluminum with the requisite stiffness and strength requirements (THE IRON AGE, Sept. 17, 1942).

Plastics likewise have been playing a more extensive part in aircraft. The wide range of applications of this material have been adapted to more than 400 different airplane parts, formerly made of metal, in one modern Martin bomber alone. Radio masts, equipment supports and housings, control quadrants, brackets, structural parts, bomber noses, turret and pilot windshields, wing flaps and tips, and many other parts are made from plastics and plastic-bonded plywood in the Martin ship. Plastics have played an equally important part in production processes. Cast plastics serve both for jigs and forming dies, (THE IRON AGE, July 2, 1942, p. 49) and are highly successful, it was announced by Lockheed and Vega Aircraft Corp.

Sheet Metal Forming

Development in the forming of sheet metal aircraft parts has progressed rapidly since the beginning of the war, mainly because production rates have been upped to the point that mass production methods can be utilized. Stretch forming, Kirksite drawing dies, forming with hydraulic presses equipped with rubber-filled platens, and forming convex flanges and joggles in sheet metal parts are all mass production methods or materials now, involving new techniques (THE IRON AGE, May 28, June 4, 11, and 18, 1942). A former manufacturer of automobile bodies, going into bomber wing mass production, broke assembly operations down, used double-action dies on mechanical presses for deep forming, and developed a number of other tricky production innovations such as refrigeration of 24 SO sheets,

Sheldon BBU-1242
WQ Precision Lathe

This quality 12 in. ball bearing tool room lathe is built for precision work and will retain its accuracy under long and hard usage. It has extra collet capacity (to 1" round), the finest precision ball or roller bearings obtainable, an improved heavy-duty, double wall apron with power cross feed; full quick change gears and full bowl headstock. Its improved Sheldon 4-speed, V-belt, lever-clutch operated, underneath motor drive is entirely enclosed in the pedestal leg and has anti-friction bearings. It is so designed that spindle belts operate thru a *standard* 1-piece bed. This bed is bridge-braced with heavy cross girts and has hand scraped ways—2 V-ways and 2 flat ways.

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Cutting-Off Blades

BECAUSE:

1 They are scientifically designed and made of material that will withstand shock and resist abrasion.

2 The hollow-ground top causes chip to collapse and thus pull away from sidewalls of cut so surfaces are of unusually fine finish.

3 A combination of proper and accurate machine-ground clearances contributes in successfully reducing friction to minimum.

4 Luers Blades have longer life; they are usable within an inch of their entire length.

5 The space created by the collapsing action of the chip in pulling away from the sidewalls allows the coolant to reach the cutting edges.

6 Being machine-ground accurately to definite standards, Luers Blades always possess the required uniform clearances.

7 Special Holder permits ease of blade removal and quick replacement in exactly same position without disturbing setup

8 Grinding is simplified. Only front face of blade is ground. All other surfaces remain unchanged; constant clearance is maintained.

9 The free cutting action obtained through the collapsing of chip prevents chip binding on the face of piece being cut off. In most cases, this eliminates second facing operation.

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The Blades That Reduce Friction

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a flowing machine for strip and extrusions, and special rivet backers (THE IRON AGE, June 25, 1942, p. 33). The versatility of stretch-forming on double-acting hydraulic presses was proved in production at Lockheed Aircraft Corp. and some innovations developed to speed production and ease the difficulty of stretching shallow contours (THE IRON AGE, Oct. 1, 1942, p. 69). The use of low cost die sets for punching rivet holes and interchangeable subpress type punching dies have proved suitable for punching various rivet pitches quickly and for notching operations on bulkheads (THE IRON AGE, Aug. 27, 1942, p. 52). Bell Aircraft Corp. extended the use of drophammers in forming parts for the P-39 "Airacobra," some of which are very complex (THE IRON AGE, Aug. 27, 1942, p. 59).

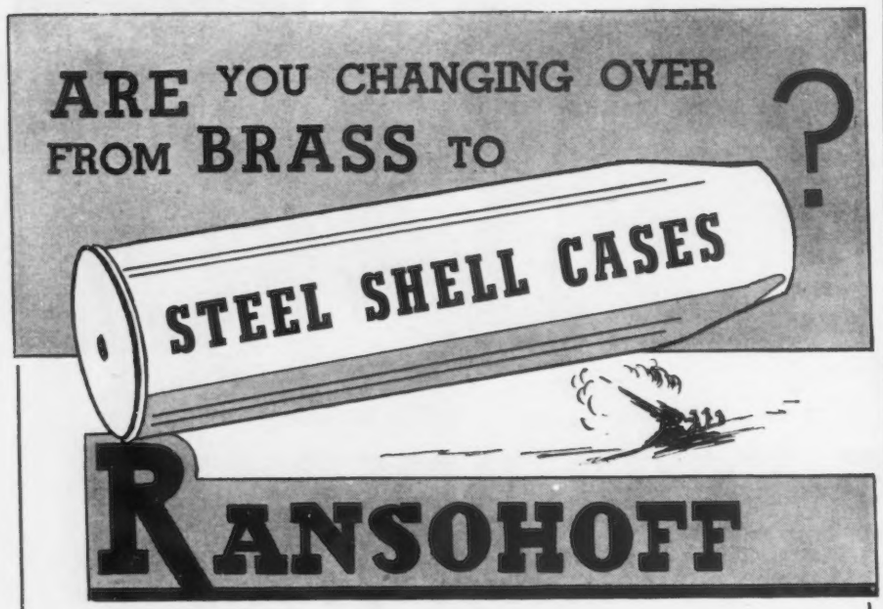
Developments were also forthcoming in the fields of heat treating aluminum (THE IRON AGE, May 21, 1942, p. 47 and Oct. 29, 1942, p. 40); spot welding aluminum (THE IRON AGE, Jan. 29, 1942, p. 29); precision pipe bending (THE IRON AGE, June 11, 1942, p. 62); overcoming aircraft part anodizing tank short circuits (THE IRON AGE, Oct. 1, 1942, p. 98); template manufacture (THE IRON AGE, Feb. 5, 1942, p. 60); and jig design for holding light sheets for riveting (THE IRON AGE, July 30, 1942, p. 50).

Advances have been made in many of the phases of aircraft technique, evolving both from the engineering departments and from the man on the production line. Heat therapy moved out of the medical into the aircraft field with a development at Martin. A difficulty in riveting aluminum skins over spars and ribs to form wings has always been the unavoidable wrinkling and buckling of the skins under the pounding of the rivet-hammers, thus interfering with the air flow over and under the wing. A system whereby the various sheets of aluminum that make up the skin, riveted together on a wood frame shaped like the wing, are heated by a skin heater eliminates these wrinkles. The skin heater, which might be described as an oversized electric heating pad, is laid on top of the skin, fitting snugly over the entire contour of the wing. Heated to 140 deg. F., which causes sufficient expansion to rid the skin of wrinkles and buckles, the skin is quickly stitch-riveted around the edges and along the ribs. When the heater is removed, the skin shrinks taut as a drumhead.

It is interesting to note how the man in the shop and on the assembly line has entered into the spirit of doing a better job, a quicker and cheaper one. Aircraft builders have urged through campaigns and contests the development of production techniques by employees, and it is quite understandable that the man on the line came through with many suggestions, some only minor and some quite valuable, but nearly always practical and adaptable. Following are some of the suggestions of employees handed to management.

Company: Consolidated Aircraft Corp. Subject: Precision Punch for Template Holes.

• This suggestion presents a



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Ohio Ferro-Alloys Corporation

Canton, Ohio

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method of punching for transferring holes in one template to another through the use of a pressure pad. The pad is equipped with a flange projection that acts as a pilot for locating purposes. To locate a hole, a hole concentric with the flange that carries a punch is used. Thus, the pilot flange is located in the hole of one template and the punch press pierces a hole in the companion template concentrically.

Company: Consolidated Aircraft Corp.
Subject: Countersink Tool Design

• An adjustable stop placed on a new countersink tool design eliminates scratching of material and wear by ordinary stops. The new tool design eliminates wear on stop bearings which usually require frequent adjustment.

Company: Consolidated Aircraft Corp.
Subject: Ball Countersink Pilot

• In countersinking heavy material, holes often are not perpendicular to the work. Consequently, countersinks are often lopsided and attempts to straighten the countersink results in broken pilots. A ball shaped pilot acts as a ball and socket, permitting the countersink to be straightened without breaking the pilot.

Company: Douglas Aircraft Co.
Subject: Interchangeable Tool Holder

• A holder bar designed so that various sizes of lathe cutters can be interchanged saved as much as 75 per cent of the time required by previous methods of changing tools in machining a hydraulic booster valve.

Company: Consolidated Aircraft Corp.
Subject: Right Angle Drill Holder

• With a little ingenuity, a housing can be built that will eliminate the tendency of a right angle drill to twist in the operator's hand. The holder not only prevents such twisting but also adds to the convenience of the operator using the tool.

Company: Douglas Aircraft Co., Inc.
Subject: Overhead Drilling

• By supplying controlled air pressure through a Norgren regulator, drill breakage was reduced. Through the elimination of the use of two Logan valves, two vertical check valves, a horizontal check valve, four solenoid valves, six Micro switches, an air gage, and several pipe fittings, the breakdown possibilities of the tool were reduced 90 per cent. The machine as now set up drills three holes to one previously drilled, making it possible now to drill 24,000 holes per day on B-17f wing spars.

Company: Douglas Aircraft Co., Inc.
Subject: Combination Broach and Burnish Tool

• A top award winning suggestion, a combination broach and burnish tool, is a simple but unique mechanism used to complete the hole roughed out in Oilite bushings. The tool, attached to the standard shop hand press with lever action, consists of a bar which is a combination broach and burnisher. The tool has a cross-section similar to that of the bushing hole to be formed, and on the surface is a series of cutting edges each of which is in a plane at right angles to the tool

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(4 times as cold as the stratosphere)

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COMES THE WEAPONS
FOR VICTORY
GET YOURS INTO THE FIGHT!
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TOOL BREAKAGE IN YOUR SHOP

Tool breakage due to improper handling of tools, etc., has been climbing at an appalling rate lately. Much of this undoubtedly is due to the introduction of large numbers of workers with no previous industrial training.

In an endeavor to help you reduce tool breakage in your shop, Genesee has produced and is making available without charge to users of **"TOMAHAWK"** tools a series of educational posters illustrating the effect of careless tool handling on the war effort.

These dramatic posters, measuring 2⅓ by 3½ ft. and in 3 colors are designed for mounting next to your tool room windows and emphasize that THERE IS JUST SO MUCH TOOL STEEL.

A new poster will be supplied every other month, thus providing a continuously fresh slant on this vital subject.

Write or wire today if you wish to be put on the list to receive these posters regularly—advising us of the number of posters you will need to cover your plant requirements.

The supply is necessarily limited

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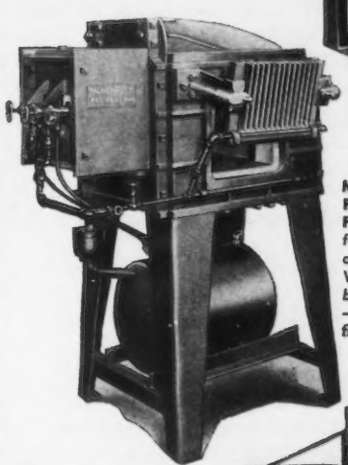
..."ONE THAT WILL STAND WELDING HEATS UP TO 3300°"

MAHR Combination Forging and Welding Furnace, *like illustration or can be made in wide hearth or car type. Special sizes or types can be designed.*

This good customer of ours, who for many years has depended on MAHR Performance-ability, had been trying to make a MAHR Forging Furnace do double duty at the extreme heats he required for welding. So he put his problem up to Mr. A. J. Nordenson, our Executive Engineer, who watched the welding operations in his plant and soon saw what was needed. "We'll build you a 'Super' Furnace, to stand the welding heats you use and also handle forging work," he told the customer.

"The difficult we do at once—the impossible takes a little longer"—might well be the battle-cry of MAHR Engineers. If you have a heat treating "nut" that's hard to crack—consult MAHR for any size or type of heat processing equipment, from bench type to the largest car or continuous type. Wire, write or phone today.



MAHR No. 35 Portable Forging Furnace, *for small forging operations and rivet heating. Vacuum fuel feed by compressed air—safe—very efficient.*

MAHR Crucible Melting Pot, *made in a range of sizes.*

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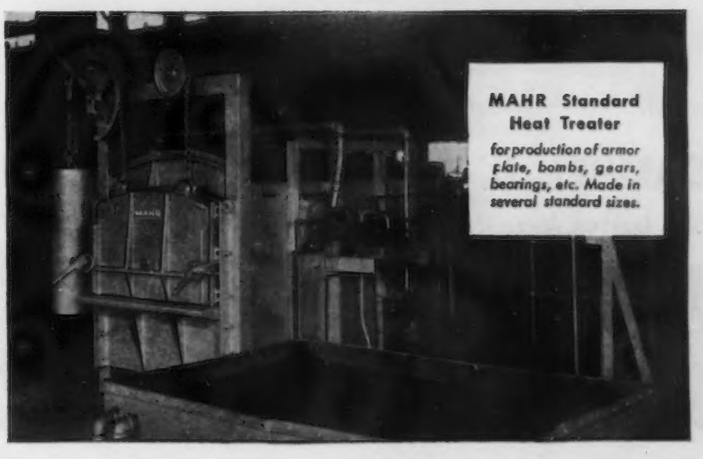

MAHR Standard Heat Treater

for production of armor plate, bombs, gears, bearings, etc. Made in several standard sizes.

axis. The broach is sent through the bushing and since the cutting edges are progressively higher, each succeeding tool removes an additional amount of metal. A slightly greater diameter, semi-round part of the bar is then forced through to burnish the hole just broached. This is done in one operation at a 60 per cent saving of time over old methods. It is estimated that 90 per cent of the busying work in aircraft production can be done in this manner.

Company: Douglas Aircraft Co., Inc.
Subject: Metal Shearing

• The versatility of a large cutter blade is increased by the use of an adjustable gage and supports for the shear, making it possible to cut exceptionally large and thick material as well as small pieces. The cutting operation is also made more accurate and considerably faster.

Company: Douglas Aircraft Co., Inc.
Subject: Wing Slot Design

• An improvement in the design of a wing slot for the Douglas Dauntless, a single motored dive-bomber, saves nine sq. ft. of duraluminum sheet stock per ship by eliminating 20 attaching angles. The idea further saves six man-hr. per ship and reduces sub-assembly time. Spot welding instead of riveting is used.

Company: Boeing Aircraft Co.
Subject: Sheet Metal Slotters

• Designed to speed production of the B-17 Flying Fortress, a multiple-tubed hydraulic punch cuts V-slots in the circumferential stiffeners that support the fuselage of the ship. This hydropunch turns out work 45 times as fast as the machine that was previously used.

Company: Consolidated Aircraft Corp.
Subject: Power Brake Fixture

• A new tool used on a power brake permits making opposite bends in sheet metal simultaneously. The bends can be made to any angle from 0 to 90 deg., up to 1.5 in. apart. With the same tool, joggles can be made as with joggle dies, permitting quicker and easier setups. On joggles requiring 90 deg. bends, only one operation is required and high quality work is possible.

Company: Douglas Aircraft Co., Inc.
Subject: Improved Drophammer Dies

• In drop hammer forming of dural, corrosion resisting, or heat-treated sheet stock, buckling, pulling, cracking, and wrinkling, resulting in waste and spoilage often occurs. Starter dies have been employed, but still sharp corners deep-sided indentations often cause material waste. It was suggested that instead of a flat holding edge, a wavy S-curve be used. Dies were made up and found to be highly satisfactory. The idea allowed enough excess material and holding area so that when the part was struck on the finish die tears or wrinkles did not result.

Company: Douglas Aircraft Co., Inc.
Subject: Forming Top Dies

• A large heating plate and oven arrangement that saves 75 per cent in time over old methods used in preheating Kirksite dies before lead top dies are poured was developed. The preheat is done to even the temperature of the molten lead which is poured to make the top die. Preheating prevents warpage and makes for a

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This new model traveling table face grinder, ruggedly built for relentless production, takes work 10″ to 12″ high. Table length is 72″, width 16″. A 10 H. P. motor mounts a 20″ cylinder grinding wheel for medium duty service. Two-speed table traverse powered by 3 H. P. motor.

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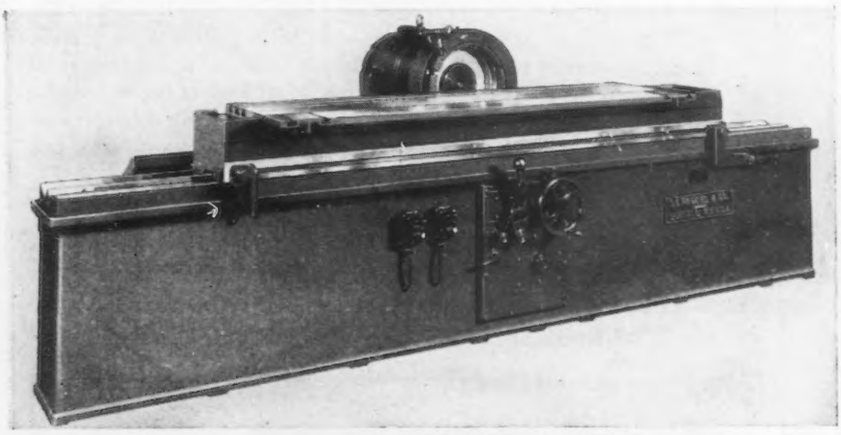

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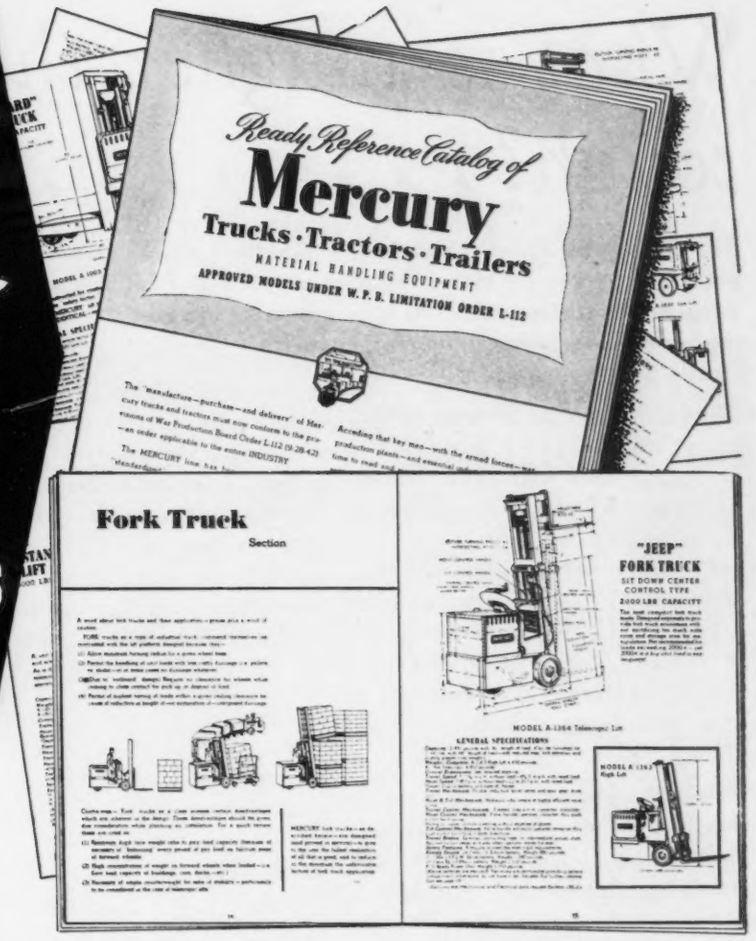

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What is tougher than tough?

Sounds like the poser the physics professor puts to his class, "If an irresistible force meets an immovable body, what happens?" Only this one is simpler.

Malleable iron, as ferrous metals go, is "tough" in the sense that it is ductile and will bend before breaking. But real toughness is more than mere ductility — it's the *combination* of high ultimate strength (125,000 pounds in a machined 13% manganese steel test bar), plus a low yield strength (40,000 pounds) and a high elongation (50%) before fracture.

Their toughness alone would qualify austenitic manganese steel castings for many of the strenuous duties they discharge, but they have another invaluable property. More than any other steel, they increase in hardness on the wearing surfaces under repeated impacts and pressure; to as much as 550 Brinell in the severest service.

You have, then, a combination of properties in genuine manganese steel that enables a conveyor chain, sprocket, gear, sheave or wheel to stand up under destructive stresses and at the same time to resist the attrition of abrasive materials. No wonder "The Toughest Steel Known" often lasts ten times as long as ordinary ferrous metals!

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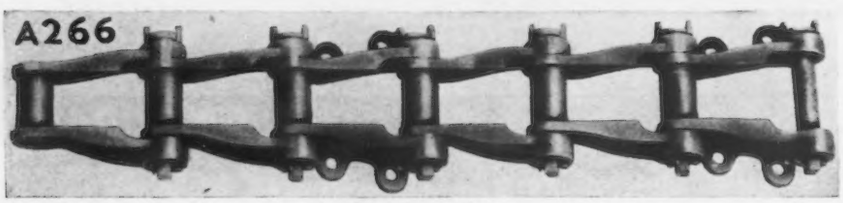
So the answer to "What is tougher than tough?" is tough-hard manganese steel — and it's also the answer to innumerable equipment maintenance problems. Catalog 59 will give you 64 pages of facts and pictures concerning "The Toughest Steel Known."



Copper mold machine track wheel (C420B) with pressed-in trunnions and one of many types of manganese steel conveyor chain (A266).

If we lose the war, the victor will seize your scrap in a hurry!

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smoother surface where the two metals contact, thus saving time required for grinding and polishing before parts can be stamped. These dies are used in drop-hammers in stamping both aluminum and steel parts.

Company: Lockheed Aircraft Corp.
Subject: Welding Positioners

• Speeding up welding of heat-treated tubing, welders work on small parts clamped to a turntable which they rotate with their feet. An automatic torch lighter on the side of the table permits turning the torch on or off without touching the regulative valves of the handle. A small flame relights the torch as it is picked up.

Company: Lockheed Aircraft Corp.
Subject: Electrode Tip Gages

• Rejections of imperfect spot-welds due to electrodes on which tips have become too thin is eliminated by a simple electrode end measuring device. A U-shaped scrap of plywood and a steel rod with a handle on it that slides through a hole on one side of the U accurately measures the end thickness of electrodes. By placing the end against one side of the U and inserting the rod until it strikes the tip, the distance between the outside of the U frame and the rod handle determines the amount of metal remaining on the electrode tip.

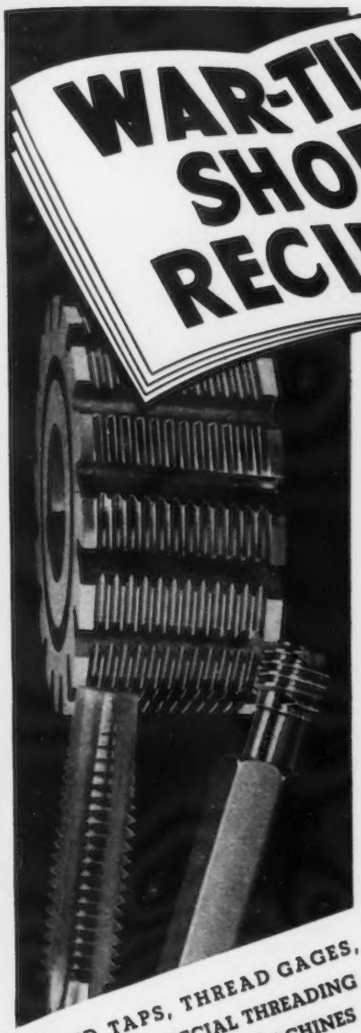
Company: Lockheed Aircraft Corp.
Subject: Air Cooled Welder Tip

• A new welder tip that is finned with dural much in the same manner as a cylinder head is finned carries off the heat from welding quickly. This keeps the handle and the gas mixing chamber cool and increases tip life 50 per cent.

Company: Vega Aircraft Corp.
Subject: Tube Marker

• Faster and more accurate single or multiple marking of tubing with graphite rings to indicate points for bending is possible with an employee developed fixture. The arrangement permits even inexperienced operators to mark the tubing accurately. Markers, one for each line to be made on the tube, are adjusted and tightened into place with thumb screws along a rail. Placement of the markers is determined by a

WAR-TIME SHOP RECIPES *for thread production*



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PRODUCT	TIME EXPOSED	CONDITION
100 Octane — Aviation Gasoline	5 yrs.	O.K.
Ammonium Nitrate	6 mo.	O.K.
Formaldehyde	1 yr.	
190-Proof Grain Alcohol	1 yr. 9 mo.	O.K.
Caustic Soda	1 yr.	O.K.
Vegetable Oil	2 yr. 1 mo.	O.K.
10% Sulphuric Acid	1 yr. 9 mo.	O.K.
Butyl Alcohol	1 yr. 9 mo.	O.K.
Methyl Alcohol	1 yr. 9 mo.	O.K.
Ammonium Sulphate	1 yr. 9 mo.	O.K.
Tannic Acid, 10%	1 yr.	O.K.
Ammonium Chloride	1 yr. 9 mo.	Good
Fish Oil	1 yr. 9 mo.	O.K.
Calcium Hydroxide	1 yr. 9 mo.	Good
Mercuric Nitrate	1 yr. 9 mo.	O.K.
Sea Water	2 yrs.	O.K.
Sodium Chloride	1 yr. 9 mo.	O.K.
Potassium Sulphate	1 yr. 9 mo.	Fair
Potassium Nitrate	1 yr. 9 mo.	O.K.
Lead Acetate, 10%	1 yr.	O.K.

Amercoat DIVISION
AMERICAN PIPE AND CONSTRUCTION CO.

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steel measuring tape riveted to the base. Roller bases hold the pipe in position, and one turn of the tubing is sufficient for each marker to inscribe a black "pencil mark" around it. The marker is easily adjusted, easy to handle, and marks the tubing legibly.

Company: Vega Aircraft Corp.
Subject: Tube Bender

• A new device for precision tube bending through a unique system of gages permits bending or rotating any type of small hollow tubing to within 0.5 deg. of accuracy. Forming blocks of a quick clamping type containing special forming grooves prevent the tubing from being flattened in bending. The device features a metal rod with a 360 deg. protracting dial and a protracting base along with a 6 ft. flexitape rule. The tube is placed between the grooved forming blocks and manually turned to the desired angle, as shown on the protracting dial.

Company: Consolidated Aircraft Corp.
Subject: Heavy Pipe Bender

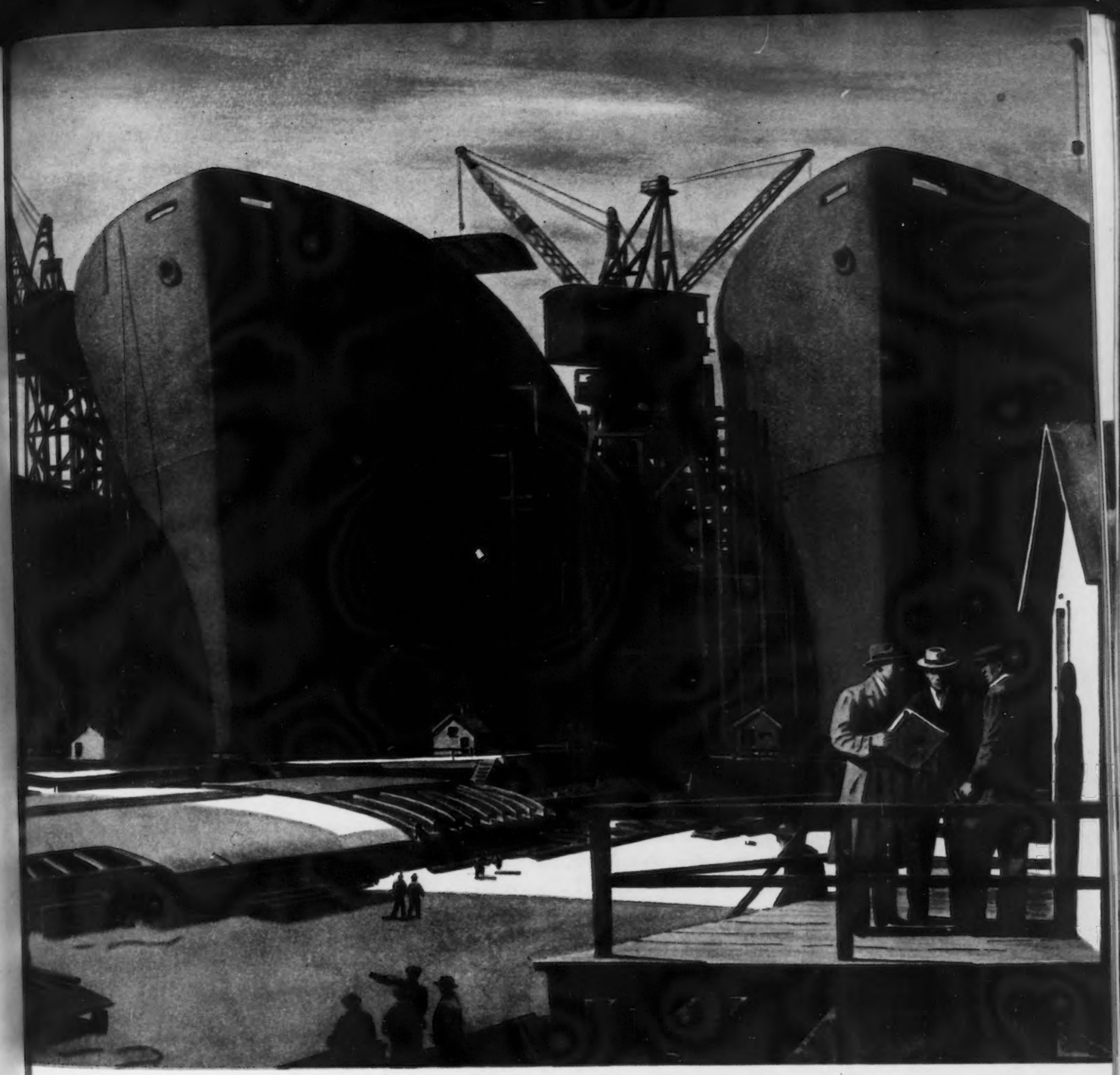
• A heavy jig into which is built a grooved forming member permits bending heavy steel pipe quickly and accurately. The pipe is held in a vise-like arrangement and a lever, operated manually, forces the pipe around the grooved former. Bending may be facilitated by heating the pipe in the area to be bent.

Company: Douglas Aircraft Co., Inc.
Subject: Shell Magazine Loader

• A wooden stand that holds the gun magazine drum eliminates difficulties in forcing shells into the magazine slot against the force of a coiled spring. By use of a rachet, the tension of the spring in the magazine is relieved, enabling the shells to be inserted without unnecessary strain on the fingers. The loading operation can now be done by one man in five minutes whereas it formerly required three men 15 minutes to load the magazine.

Company: Consolidated Aircraft Corp.
Subject: V-Block Drill Jig

• This tool is merely a variation of the V-block, universally used for drilling holes in tubing, rods, and shafting. It has been adapted to drilling holes in round members that have already been installed on



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Howell Motors help build our ships— They also serve at sea

In the shipbuilding industry as in the automotive and many other industries, Howell Electric Motors are playing an important part . . . In the shipyards—on vital machine tools and other special equipment—Howells are used extensively.

Many of our newest and finest ships are going to sea equipped with Howell Electric Motors — on the winches, pumps, elevators, heating and ventilating systems.

The men and women who build and distribute Howell Motors are proud of their war production record. Proud to be turning out the precision-built motors that are going into vital war work, helping build ships, planes, tanks and trucks. Proud to be working in the defense of American ideals, principles and objectives.

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CHARLES C. DOYLE
President

I have a story to tell to the executives of big companies who want to get more production, or some special type of production, ***FAST.*** This is no pipe dream. This is what we have done, and are doing today, for some of the important prime contractors. We have made aircraft parts, gun sight parts, tank parts, landing gear parts and subassemblies, just to name a few.

The WPB people call our operation a Vertical Pool. We were about the first successful large scale operation of this kind, starting long before Pearl Harbor. The members of our group are thoroughly experienced and dependable. They include many small shops where the owners are skilled operators working on their own machines, and some large plants that have specialized facilities available from time to time.

And please get this straight—The J. E. Doyle Company is not a middleman performing simply a selling function. We have a skilled production and engineering staff which provides the technical and supervisory know-how that most of these small shops lack. We do the "paper work" which they are not set up to do themselves. We see that they are provided with the necessary tools, jigs and fixtures. We take the responsibility for results.

We are not price cutters, but our costs are amazingly low. The work is allocated to the various shops according to their ability to do the job ***satisfactorily, immediately*** and at a ***reasonable profit*** to themselves.

The essence of our service is ***SPEED.*** Give us the job today and we'll start turning it out tomorrow. I mean that literally. That's the one thing that everyone says is most important and yet I find it the hardest to get across to prime contractors. They just can't understand how we can move so fast.

That's why we are taking this means of telling our story. Some of you big executives will have the imagination to see in this Smaller Business Pool operation the answer to your production bottlenecks. We'll gladly furnish references.

Phone, wire or write today.

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the ship and cannot be conveniently taken out. The design is such that a U-shaped clamp or yoke with lips on each and that slip into slots in the sides of the V-block permit easy set-up. A thumb screw through the curve in the yoke clamps the tubing tightly in the V-block, so that drilling is facilitated. Several V-blocks may be made up for a single clamp and with two or more various sized holes in each V-block, a variety of sizes is possible.

Company: Cessna Aircraft Co.
Subject: Spar Contour Sawing Jig

• A jig consisting of a central table to which the wooden spar blank is clamped holds the spar in position while a bandsaw on a carefully positioned monorail cuts around the blank, leaving an exact spar outline. An electric planer follows the saw and the job is complete. Two men turn out 14 spars in an 8-hr. shift where seven men formerly made only three spars in the same time using a master pattern, a hand circular saw, and a hand planing method. Rejects are reduced because of the increased accuracy of the new method.

Company: Lockheed Aircraft Corp.
Subject: Material Handling

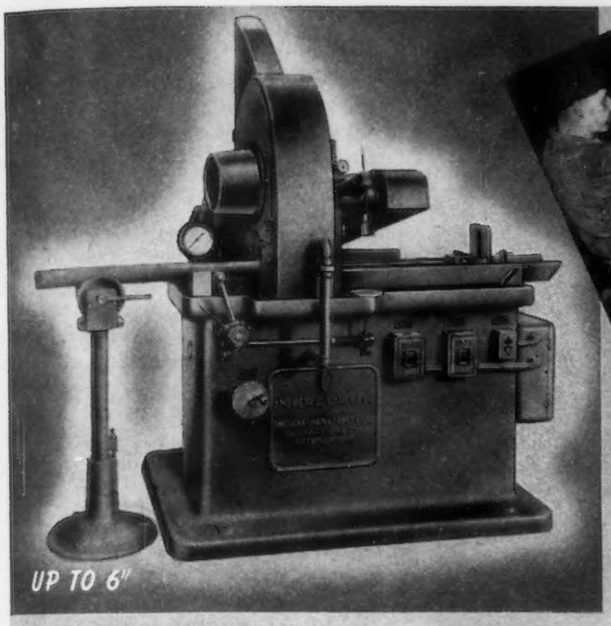
• Portable, knock-down stock tables with corners cut out to form working space, the table partially surrounding the operators, permit faster loading and unloading of the circular beds of hydraulic presses. Production has been increased 25 per cent and operator fatigue is reduced. Usual practice is to surround such a press with three loading tables and one unloading table.

Company: Glenn L. Martin Co.
Subject: Belt Conveyor Lines

• The use of a belt conveyor line along which all various machine and hand operations necessary in making certain airplane sub-assemblies permits increased production and downgrades work so that inexperienced operators can be introduced to an operation and in a short time be familiar with it. Assemblymen pace the line, and operations are performed on the parts as they pass operators along the line.

Company: Vultee Aircraft Co.
Subject: Press Material Handling

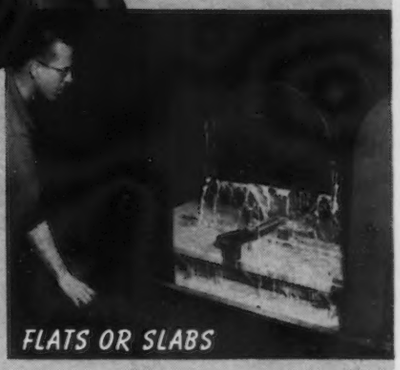
• Cycle operation has been added to hydraulic press operations at Vultee by means of a circular table onto which parts are automatically



No. 401 CAMPBELL CUTAMATIC. Abrasively cuts steel up to 6" dia. Equipped with hydraulic clamping and wheel feed. Proper coolant control.

No. 213 CAMPBELL. For cutting tubing up to and including 3½" and solids up to and including 2" dia. Features micrometer stop bar, new type work holder, automatic clamp for long and short work. Proper coolant control.

No. 302 CAMPBELL. Primarily designed for making long cuts through flat or slab materials. Hydraulic automatic reciprocating wheel feed. Proper coolant control.



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Whether you are cutting low carbon, high carbon, alloy, stainless, hardened, annealed, or unannealed steels; ferrous castings, non-ferrous alloys, glass, stone, ceramics, or plastics—

Whether you cut solid bar, tubular or flat stock—

You will find it worthwhile to check on abrasive cutting—specific jobs in your plant—with the **CAMPBELL** Engineering Department.

Send in complete data—including size and type of material, length of stock before cutting, length of cut-off pieces, production required per hour. With that as a foundation, the Engineering Department can work out production procedures and costs for your specific jobs—and offer help in other ways. Check with **CAMPBELL** on abrasive cutting problems.

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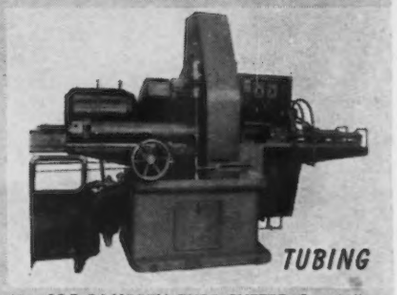

No. 425 CAMPBELL TUBE CUTTER. Specially arranged for tube cutting. A rotary machine for cutting long length tubing up to 9" diameter into short pieces, such, for example, as those used for ball-bearing races. Proper coolant control.

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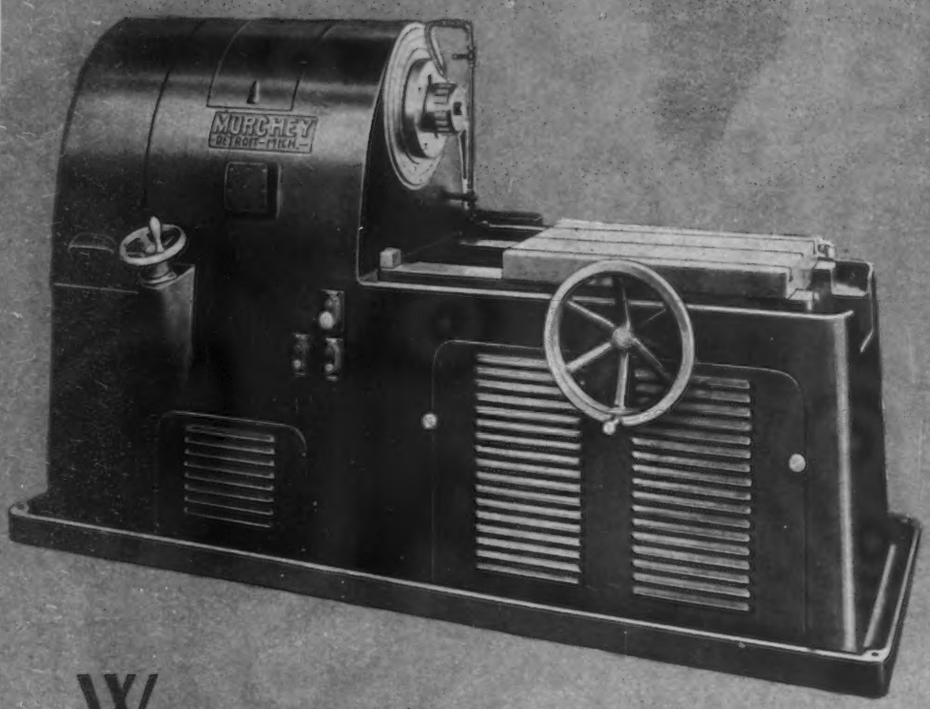
NIBBLING MACHINES

If you have the problem of cutting odd shapes of ferrous and non-ferrous metals, or other composition sheets economically—or if your problem is the production of similar parts in quantities up to several hundred where the cost of dies is a prohibitive factor—Campbell Nibbling Machines will put an end to all such production bottle-necks.

CAMPBELL No. 250 NIBBLER

High speed production unit that handles up to ¼" mild steel (3/16" stainless) in widths to 72". Note two hand control. 3 speeds. Adjustable stroke. Eight other models.

There's A Murchey for MOST Threading Jobs!



WHETHER it's a question of size, tolerance or production, Murchey threading equipment covers a wide range in cutting external or internal threads.

The new #42 Murchey Thread Milling Machine extends the range into the zone of larger diameter threads from 4" to 12", external or internal, right or left hand, where extra accuracy is needed.

The use of full-length annular milling cutters, and accurate control of pitch and depth produces precision-cut threads at a production rate which will interest you.

TYPE "G" SELF-OPENING DIE HEAD

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MURCHEY MANUFACTURES ALL TYPES OF COLLAPSIBLE TAPS SELF-OPENING DIE HEADS AND SHELL TAPPING MACHINES

Murchey

MACHINE & TOOL CO., DETROIT, MICH.

FEATURE CONTINUATIONS

loaded. The table revolves to place the parts under the ram, and formed parts are simultaneously carried around to the unloading station.

Company: Vega Aircraft Corp.
Subject: Cleaning Sheet Metal for Spotwelding

• The substitution of phosphoi and chromic acid for the common used hydro-fluoric acid in cleaning sheet metal to be spotwelded has not only resulted in a cleaner, brighter surface but has helped speed production. Under the cleaning system previously used, there was a tendency for the aluminum sheet to alloy with the copper tip of the electrode, necessitating cleaning the tip after every 10 or 15 spots. By using a combination of phosphoric and chromic acids, the tips do not have to be cleaned oftener than every 500 to 800 spots. Furthermore, the sheet metal may be left in the cleaning tank 3 to 30 min. without injuring the metal. Under the old method, immersion had to be timed almost to the second.

Company: Vega Aircraft Co.
Subject: Oil Filter Cleaner

• An outer tank covered with shellac, asbestos, and canvas standing on a similarly covered 4-in. electric heater plate, into which is fitted an inner tank, is used to clean oil filters for Pratt & Whitney engines. A specially designed rack holds individual filters in place in the tank and permits easy insertion and withdrawal from the hot cleaning compound.

Company: Douglas Aircraft Co.
Subject: Marker Painting

• A paint device for putting walkway designation stripes on the tops of wings quickly and efficiently consists of a small paint receptacle which holds one-half pint of lacquer, the end of which is attached to a roller which turns on a pin axle. The lacquer is gathered into the grooved outer surface of the roller and rolled out in contact with the surface to be painted, making a straight even stripe. The cost of making the tool is about $10. The operation, now done in 20 min., saves about 3½ hours per plane. It eliminates a spray operation on the assembly lines, gives a better line, saves lacquer, and saves 168 ft. of gummed edge masking tape formerly used.

FEATURE CONTINUATIONS

Company: Lockheed Aircraft Corp.
Subject: Electrical Installation Checker

• A universal electrical tester was devised to give power continuity, check for shorts, and duplicate ship operation of all electrical subassemblies. Based on the fact that the main switch box is the heart of a plane's electrical circuit, the connecting link between all electrical equipment on the ship, the device transfers bench testing of all wiring to the installed apparatus. It checks all wires for shorts to the frame of the box and indicates by a red light those that are shorted. It checks all plug terminals for shorts to the shell and adjacent pins, indicating which are shorted and where. All switches in the switch box operate on the tester the same as in the ship and each switch has a separate light on the test panel to indicate if it is properly wired.

Company: Curtiss-Wright Corp.
Subject: Electric Conduit Coatings

• A new production method evolved at Curtiss-Wright that meets the need for faster fabrication of parts is a machine that tins and saws to accurate lengths flexible electrical conduit that has been installed in fighter and cargo planes. The new machine, using a standard cut-off saw, reduces conduit tinning and cutting time by 50 per cent in comparison with other methods. The conduit is fed through heater blocks in the machine along with resin core solder which tins the conduit. The cut-off stop is set to bring the tinned section of the conduit directly in the path of the cutting saw.

Company: Cessna Aircraft Co.
Subject: Plywood Former

• An adaptation of the tailor shop "pants presser" is used to form plastic-bonded plywood for the leading edge of the wing. Made in the proper form for the leading edge, the machine steam-heats and bakes the plywood into shape in 20 min. Formerly the soaked plywood was tacked to the leading edge and allowed to dry at room temperature and humidity. The new process saves about three man-hours per wing.

° ° °

MURCHEY TYPE "M"
COLLAPSIBLE MACHINE TAP.

Murchey Taps and Dies assure you of the best in threading operations. Murchey's years of experience and engineering skill are at your service.

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ABLE TO TAKE IT--

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For *Victory*

and For Your Future...

BUY WAR BONDS AND STAMPS!

Your Home . . .
War Bonds and Stamps provide a good way to save for the home you have always wanted to own.

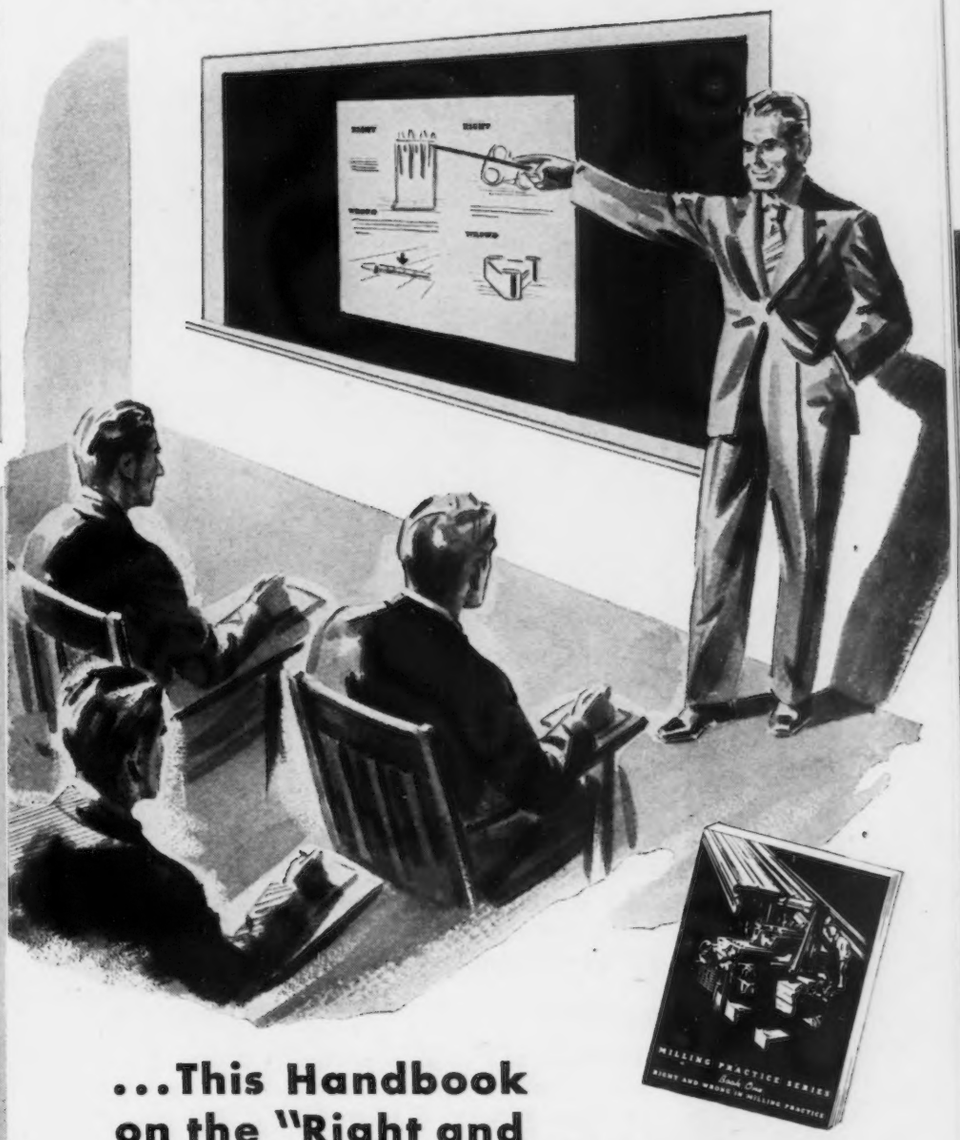
Your Children's Education . . .
War Bonds and Stamps — a good way to lay aside funds for educating your children.

A New Car For Your Family . . .
Save now with War Bonds and Stamps for that new car you will want to buy when the war is over.

V '43 FOR VICTORY

Buy VICTORY WITH AT LEAST 10% IN WAR BONDS

JUST LIKE A LECTURE ON THE FUNDAMENTALS OF MILLING...



...This Handbook on the "Right and Wrong of Milling Practice"

Even experienced milling machine operators find this handbook useful and valuable in brushing up on the fundamentals of sound milling practice.

Written in an easy-to-understand style — contains hundreds of illustrations depicting the right and wrong way of operating a milling machine — plus many valuable suggestions on short cuts in milling — and the correct care and attention of the machine.

Write for your personal copy of the newest Kearney & Trecker publication, "The Right and Wrong of Milling Practice".

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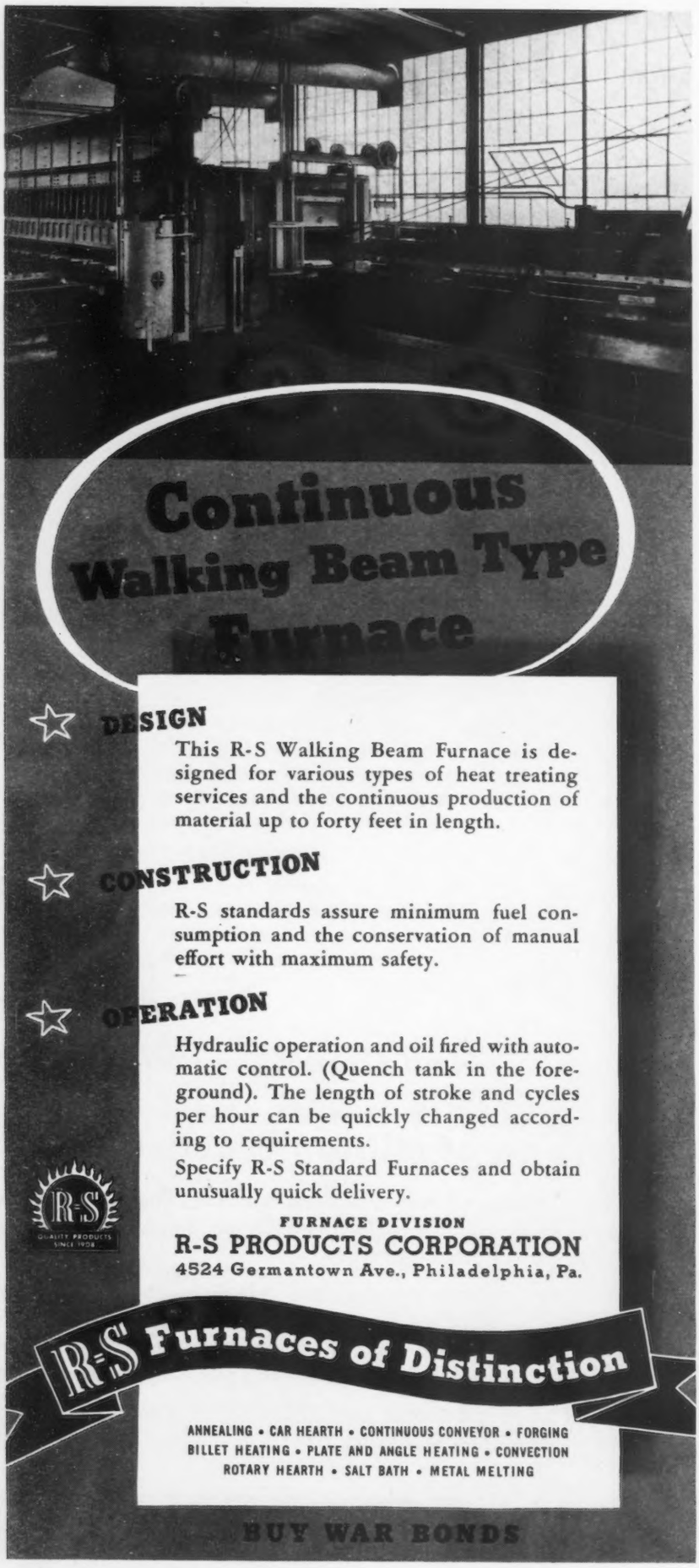
Continuous
Walking Beam Type
Furnace
DESIGN
This R-S Walking Beam Furnace is designed for various types of heat treating services and the continuous production of material up to forty feet in length.
CONSTRUCTION
R-S standards assure minimum fuel consumption and the conservation of manual effort with maximum safety.
OPERATION
Hydraulic operation and oil fired with automatic control. (Quench tank in the foreground). The length of stroke and cycles per hour can be quickly changed according to requirements.
Specify R-S Standard Furnaces and obtain unusually quick delivery.
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ROTARY HEARTH • SALT BATH • METAL MELTING
BUY WAR BONDS

FEATURE CONTINUATIONS

Non-Ferrous Metals

(CONTINUED FROM PAGE 242)

is trickling away from the steel mill tributaries.

It is probable that NE steels, with their low nickel contents, will put their mark on the post war world, but this is little cause for alarm to traffickers in nickel. Big, heavy steel sections still must be high-nickel. NE steels require closer heat treating control than high-nickel steels and it is probable that to many users high-nickel steels will represent an insurance policy. Because of improvements in forming, fabricating, working and finishing of stainless steel, and greatly increased electric furnace capacity, tremendous peacetime tonnages of stainless are expected.

Some metallurgists predict the use of great quantities of low alloy, high tensile steels, with an 0.5 or 1 per cent nickel content, where alloys have not previously been used. This prophecy is based on the increase in stampings from high tensile steels, replacing, in many instances, forgings, castings and built-up parts.

One of this year's babies, now in a state of arrested development, is monel steel, having a nickel content of 1.5 per cent and copper content of 0.80. There has been too little monel metal scrap to make this steel in any volume and it has not been offered on the general market, but it has stirred up great enthusiasm. It is said to be superior in ductility and impact value and to have especially good welding characteristics.

Some time during the first half of this year, the first Cuban nickel should come through from Nicaro Co.'s development. Nicaro, a subsidiary of Freeport Sulphur Co., began studies of low-grade (1 to 2 per cent) Cuban ores early in 1940 and in 1941 built a pilot plant at Freeport, Texas. Last spring, after the Cuban development was recommended by WPB as a war project, the company got a $20,000,000 DPC contract. About 6000 construction workers in Cuba and 300 engineers in New York are now working on the concentration plant.

The new and interesting part of Nicaro's project is its leaching process, and unfortunately details on it are withheld for the nonce. The ore, which is on the northeast

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As a Direct Hit on An Aircraft Carrier

We have fixed our sights. Our entire set-up is revolutionized. Now we concentrate on Mounted Wheels and Vitrified Grinding Wheels 3″ and under in diameter — 24 hours a day, every day.

Our central location makes speedy deliveries certain.

- Wheels flow off our production lines and into your plant in a swift, steady stream. Speed assured on all orders. Count on us to meet bottleneck emergencies.
- Valuable man hours saved in your plant. There is no waiting for wheels.
- Customers—new wartime and old—get the same high quality that has been maintained since we introduced the first Mounted Wheels 45 years ago. We can take care of all your requirements for wheels 3″ and under.

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You should have our new catalog which illustrates in actual colors and sizes the largest line of Mounted Wheels made. Send for copy today.

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ELIMINATE FIRE HAZARDS

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ASBESTOS SWEEPING COMPOUND

Classified as "Non-Combustible" by Underwriters' Laboratories, Inc.

NON-COMBUSTIBLE — Compounded entirely of non-burnable materials.

ABSORBENT—Soaks up oil and grease.

ECONOMICAL—Inexpensive; reduces cleaning costs. Available in 50-lb. bags.

Here at last—a sweeping compound that efficiently removes oil and grease deposits, yet does not create a fire hazard. Absorptive action; mildly abrasive. The ONLY product of the kind on current Underwriters' re-examination list classified as "Non-Combustible." Contains no acids or caustics; will not damage floors or injure shoes or clothing. Lessens accidents due to falls. Widely used in metal working, chemical and food plants, refineries, power plants, garages, filling stations, etc. Very economical—may be re-used until thoroughly oil soaked. Write for free sample and full information to Dept. 26.

THE PHILIP CAREY MFG. CO.

Dependable Products Since 1873

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In Canada:
The Philip Carey Company, Ltd.
Office and Factory: Lennoxville, P. Q.

HARMLESS—Contains no acids or caustics. Will not damage floors or shoes.

NON-SKID — Removes danger of accidents and possible law suits.

Cuban coast, will be strip mined, dried and ground. The ground ore will be reduced by roasting at moderately high temperatures, cooled, and put through an aqueous leaching agent. The metal recovered from the solution will be in the form of nickel oxide. Refining will be done in this country at a site not yet chosen, but likely to be Wilmington.

Nicaro's production, when it reaches capacity, should add something between 10 and 20 per cent to the U. S. nickel supply. The company, optimistic about costs, has planned the project as a permanent development. The plant has been built of a fabulous quantity of odds and ends, including steel from the World's Fair trylon, an abandoned cement plant, an Indiana hotel and a New Jersey factory. A complete Oklahoma machine shop was moved down like a Hearst monastery.

Minor Revolution:

Silver has been the comic opera metal of the war. It has precipitated an enchanting argument over whether hot bus bars are safe from thieves. It has raised a fantastic pother over whether the economic system will be as stable with silver on loan to war plants as it is with silver underground at West Point. It has produced the incredible Uncle Shylock suggestion that silver be lend-leased to our allies at $1 an oz., against a U. S. import price of 45c.

All this can be, and generally is, attributed to the sectionalism of the silver bloc and that monster child, the silver bill, which sets the price of domestically produced silver at 71.11c. an oz. and provides for the Treasury to buy it up, bury it and own it henceforth.

The conflict, however, really goes bigger and deeper. Silver is a metal in the midst of a revolution. It is a minor revolution only because silver is a minor metal, quantitatively.

Silver is taking a new role in culture. Since man first prized it, it has been primarily a decorative and monetary metal, used in tiny amounts by industry other than the "arts." In the last year, however, silver has become truly an industrial metal, not as a substitute for other metals alone, but in its own right and on a large scale. This development had started before the war, but the war has accelerated it

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INVOLVING FLUID SEALING
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enormously, and 1942 was the year when the old conception of silver and the new conception met head-on.

Most of the proponents of the selling of Treasury silver did not realize this themselves. Many of them were concerned with what they considered bad monetary ideology. To most of the others, silver had temporarily grown too big for its breeches, but after the war the breeches would fit again and in the meantime the hem could be taken out. They didn't realize that silver already has a new pair of pants.

The towering development of the year for silver is the use of silver coated steel bearings in airplane engines and for other heavy duty work. (See THE IRON AGE, Aug. 13, 1942, p. 56; and Aug. 20, 1942, p. 41).

Silver brazing alloys are now vital in the ignition systems of radial type and liquid cooled airplane engines. Each engine has 152 silver brazed joints in the shielding ring assembly and 14 joints on the spark plugs.

In shipbuilding, silver brazing alloys are specified by the Navy on 21 types of piping systems, from lubricating oil lines to expansion joints. About 20,000 ship workers have been specially trained.

The low melting temperature and fluidity of silver brazing alloys have speeded assembly of bomb noses to cases as much as 400 per cent. These brazes are used in aerial and incendiary bombs, shells, hand grenades and torpedoes. They are used on the jackets of machine guns, the rip cords of parachutes, and a hundred other places.

Richard J. Lund, chief of the Miscellaneous Minerals Branch of the WPB, estimates that war industry is now using silver at an annual rate of 145,000,000 oz., and will be using it at the rate of 227,000,000 oz. by the end of 1943, with heaviest expansion in solder, brazing alloys and engine bearings. He staggered a Senate Silver Committee hearing with the suggestion that essential industrial uses might take, at the outside, 400,000,000 oz. in 1944. Trade circles consider this figure unlikely, and the 1943 figure a little less conservative than their own.

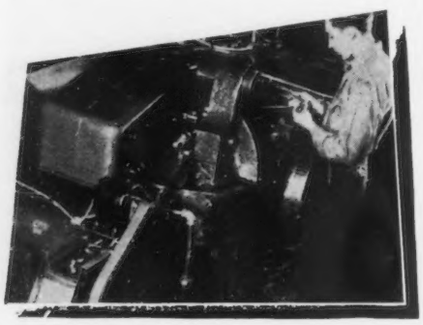
U. S. production in 1942 was

(CONTINUED ON PAGE 229)

YOU MAY BE WASTING HIGH PRIORITY STEEL!

NATURALLY you want to make most effective use of every pound of steel you can get. When your orders for bolts and rivets specify Oliver, you are conserving vital steel, because Oliver *forges* these fasteners by the upsetting, rather than the cutting method. This reduces scrap to an absolute minimum, and speeds production.

You can be supplied with the types and sizes of bolts, nuts, rivets, or other steel fasteners you need by Oliver—and be assured of using effectively every pound of steel your order requires. This is an efficient, patriotic way of best observing the restrictions on vital steel.

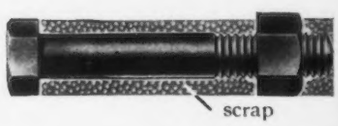


OLIVER IRON AND STEEL Corporation
PITTSBURGH, PENNSYLVANIA
BOLTS . . . NUTS . . . RIVETS
STEEL FASTENERS

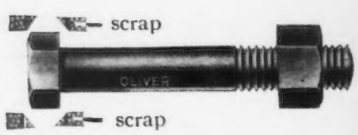
HERE'S HOW TO SAVE STEEL AND GAIN *Speed*

OVER 99% of Oliver's production of bolts, rivets, and steel fasteners is made by the steel-saving *upsetting* method. Thus you get full value from every pound of steel your priority furnishes. The Oliver method is faster . . . permits the use of tougher high-strength steels . . . and you get speed which is vitally important today.

THIS IS WASTEFUL
(Cutting-away Method)



THIS IS FAST AND SAVING
(Oliver Method)



Take advantage of the speed and savings available with Oliver production methods! Your essential steel fastener requirements will receive prompt handling at Oliver—always!

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PITTSBURGH, PENNSYLVANIA
BOLTS . . . NUTS . . . RIVETS
STEEL FASTENERS

HOWARD foremost in Magnesium Castings

The new Howard magnesium foundry has a capacity of over 500,000 pounds of castings per month. Its output during the next few months will exceed the entire volume of magnesium produced in the United States in 1938. This plant supplements the two Howard foundries where aluminum and copper-base castings are produced. This combination of facilities affords the largest production of non-ferrous castings in America.

Lightest of structural metals—two-thirds the specific gravity of aluminum—magnesium possesses the highest ratio of strength of all metals, is the easiest to machine and has high resistance to impact.

Howard magnesium castings are proving their worth in machinery and tools as well as fighting equipment; planes, guns, tanks, ships and military vehicles. One application on a four-motor bomber saves the weight of two men, as compared with the part formerly used.

The war work at the Howard foundries is revealing many civilian uses for cast magnesium parts. Some of these may effect improvements in your products. A booklet, "Non-ferrous Castings and Their Uses," awaits your request.

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ARMY E NAVY

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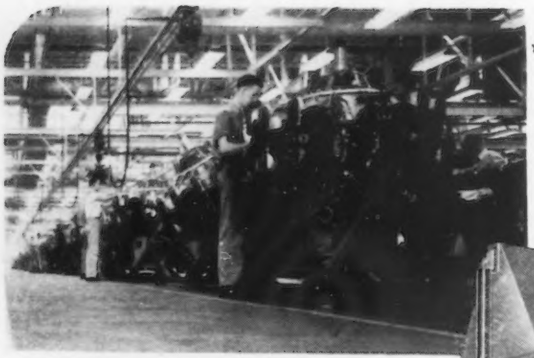
CASTINGS



★Photograph courtesy Wright Aeronautical Corp

X-RAY EQUIPMENT

used for Inspecting Parts in

CYCLONE ENGINES THAT POWER OUR FLYING FORTRESSES

Available with Complete Automatic Control

With this control, the unit opens and closes the doors, moves the dollies in and out, and exposes the films at the correct intervals—all automatically.

THIS new, compact X-ray unit was designed by KELEKET engineers for inspecting light or heavy metal parts on a fast assembly line. Speed is limited only by the rate at which the dollies can be loaded and unloaded — up to 5000 small parts have been radiographed in a single 8-hour shift.

This fast, efficient X-ray inspection tool is built to operate with your present assembly line, or can be adapted to any mass production operation.

KELEKET engineers will be glad to consult with you on any problem requiring high-speed X-ray inspection and explain how this equipment can be adapted to meet your requirements and specifications.

THE KELLEY-KOETT MFG. CO., Industrial Division
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Representatives in 64 Cities

KELEKET X-RAY

PIONEER CREATORS OF *QUALITY* X-RAY EQUIPMENT SINCE 1900

FEATURE CONTINUATIONS

Shipbuilding, Aircraft and Women

(CONTINUED FROM PAGE 258)

War Manpower Commission placed Los Angeles, San Francisco and other hitherto "Class B" coast districts in a classification ineligible to receive further war contracts? Now all substantial Coast industrial plants are in such classification.

Is it any wonder, either, that these Coast cities are, although they try not to show it, worried about their future after the war?

Possibly a bellwether for other prime contractors, Consolidated Aircraft Corp. last month announced that it would establish plants to manufacture parts and components in twelve smaller California cities where a less stringent labor situation occurs. From now on, the trend is necessarily toward decentralization.

Despite its tremendous growth in its specialty industry, aircraft, southern California has lost ground since the outbreak of war to other sections of the country. In 1939, plants in Los Angeles and San Diego counties manufactured over a third of the total value of aircraft, including engines, propellers, etc., produced in the United States, and 60 per cent of the airframes. From June, 1940, through July, 1942, however, these two counties received only 19 per cent of all aircraft supply contracts. Taking into account that a large portion of the aircraft supply contracts comprise engines and accessories, the figure is not so bad as it looks, but it points to an inescapable fact—that this section of the country must develop engine and accessory manufacturing plants if it is to retain its leadership.

Although slipping relative to other geographical areas, the eight southern California manufacturers which comprise the Aircraft War Production Council, Inc., increased their production 113 per cent since Pearl Harbor. Deliveries of cargo planes, which provided the controversial highlight of 1942 for the industry, increased more than 1100 per cent during the same period. Epitomizing the increase in efficiency as the industry gathers speed, the dollar value of airplanes produced per man hour worked was raised 36 per cent. These figures, unfortunately, do not take into ac-

BLUEPRINTS and BLUEPRINTING MACHINES

Instruments of War

WITH THEM THE GREATEST INVENTIONS USED IN MODERN BATTLE ARE TRANSLATED FROM THE DRAWING STAGE INTO REALITIES

The Nation's offensive is being waged on a Gargantuan scale... production of fighting equipment is far beyond anything in history... so is the production of Blueprints.

Thus Blueprints and Blueprinting Machines are virtual instruments of war because they provide the accepted and best method of making the huge number of reproductions of engineers' drawings and tracings which are essential for all out production lines. Further, Blueprints make them at the highest speed and the lowest cost possible.

Pease Model "22" is the finest and fastest Continuous Blueprinting, Washing, Developing and Drying Machine on the market. Its actual production speed of finished Blueprints is 30 linear feet per minute.

Among Pease Model "22" exclusive features are **Sliding "Vacuum-Like" Contact,** which smooths out wrinkles, prevents errors—**Three Speed Lamp Control,** which provides operation at 10, 15 or 20 amperes, does away with running speed and dryer heat changes—**Actinic "No Break" Arc Lamps** which burn for 45 minutes without breaking arc, resume instantaneously—**Horizontal Water Wash,** which floats prints free from tension and prevents wrinkles, stains, bleeding—**Quick Change Chemical Applicator System,** which allows change from Blueprints to negative or vice versa, economically, in 30 seconds—**Rapid Drying Drums,** which are heated by gas or electricity, and are thermostatically controlled.

THE C. F. PEASE COMPANY

2695 WEST IRVING PARK ROAD • CHICAGO

Pease Blueprinting Machines

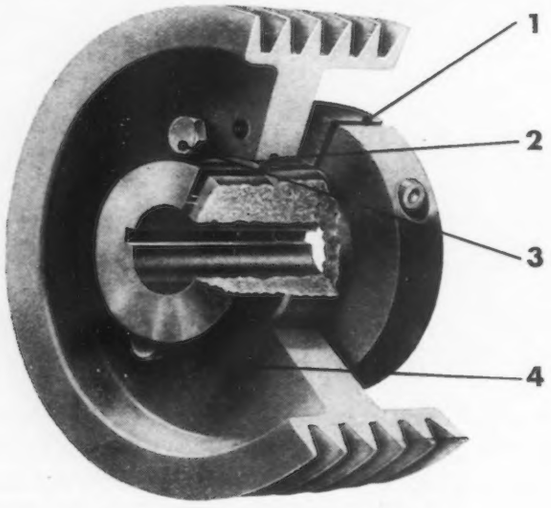
A TYPE AND SIZE FOR EVERY REQUIREMENT INCLUDING DIRECT PROCESS PRINTING

WORTHINGTON

QD QUICK DETACHABLE SHEAVES

Easy to get on
Easy to get off

...YET ALWAYS TIGHT ON THE SHAFT



1. **SPLIT HUB** for easy mounting or removal from the shaft.
2. **TAPERED FIT** between split hub and rim for easy mounting or removal of rim from hub.
3. **PULL-UP BOLTS** which pull the rim onto tapered split hub for tapered friction drive assembly and positive press fit on the shaft.
4. **TAPPED HOLES IN RIM** for using pull-up bolts as jack screws to free the tapered friction fit when detaching rim.

Ask our nearest District Office for a demonstration of the Time-Saving, Labor-Saving and Material-Saving advantages of the QD Sheave.

MV3-2

COMPLETE DRIVES **WORTHINGTON MULTI-V-DRIVES** SHEAVES OR BELTS ONLY

WORTHINGTON PUMP & MACHINERY CORPORATION • GENERAL OFFICES: HARRISON, N. J.

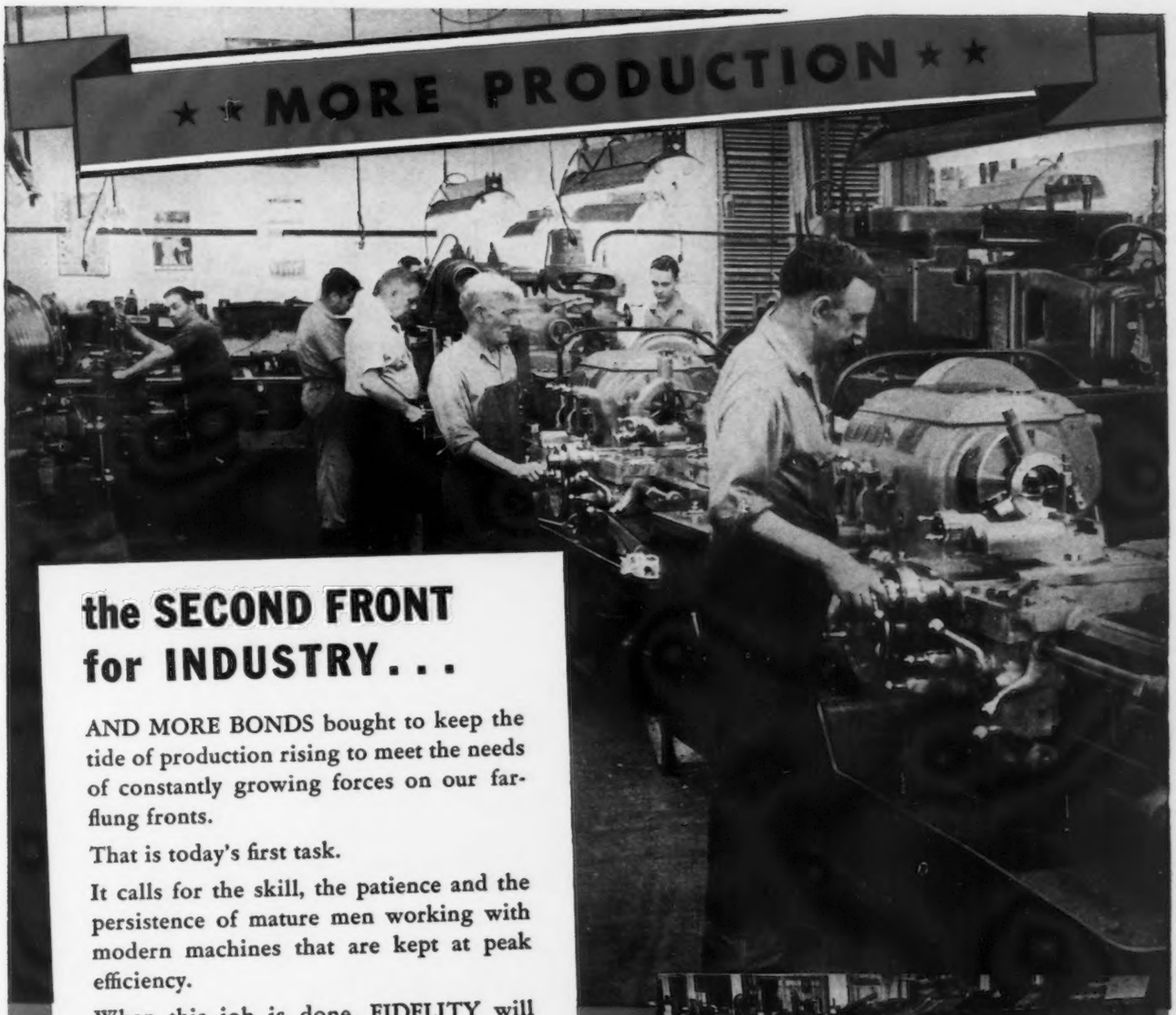
count Boeing at Seattle whose growth has been steady and production spectacular.

Shipyards Still Supreme

Pacific Coast shipyards have never slipped from their position at the head of the list in production of cargo vessels. Forty-eight of the 84 ships delivered to the Maritime Commission in November were constructed in Coast yards. Of these, 45 were Liberty ships, two were C-3 cargo ships and one a C-2 cargo ship. California Shipbuilding Corp., Los Angeles harbor, and Oregon Shipbuilding Corp. each delivered 13 Liberty ships. Richmond Shipyards Nos. 1 and 2 delivered 18 between them. Considering that each Liberty ship contains between 3000 and 4000 tons of ferrous and non-ferrous metals, these yards alone constitute a substantial metal market. And, unlike the situation in aircraft, Pacific Coast factories also are building the propulsive machinery for these ships. Remember, too, that the pace is ever quickening, and that yards which now produce 13 ships a month will be producing 15 or more before long. No one in the Coast yards expects the record keel-to-launching period of four and one-half days, established at Richmond, to last through 1943.

Since the first of the year, Pacific Coast yards have delivered more than 250 cargo vessels, and have been active as well in the repair and construction of naval units. Deliveries of cargo vessels during the first ten months of the year were approximately ten times those made in all of 1941. The 146 Liberty ships delivered by four Coast yards in the first seven months of 1942 required an average of 130 days from keel-laying to delivery. This period was reduced to 65 days for 30 ships delivered by the same yards in August, to 58 days for 37 ships delivered by the same yards in September and to 52 days for 41 ships delivered in October.

When looking to the future, West Coast boosters like to give greater emphasis to the raw metal producing facilities which are being built up in the area than to the various fabricating industries. Because of the abundance of cheap electric power which will always be available, the aluminum industry is regarded as a permanent boarder. Administrator Paul J. Raver of the Bonneville Administration has declared that



the SECOND FRONT for INDUSTRY . . .

AND MORE BONDS bought to keep the tide of production rising to meet the needs of constantly growing forces on our far-flung fronts.

That is today's first task.

It calls for the skill, the patience and the persistence of mature men working with modern machines that are kept at peak efficiency.

When this job is done, FIDELITY will resume its three decades of the development and building of intricate, automatic precision machines for Industry so that, in turn, it can better and more speedily supply a waiting and wanting world with the needs that will follow Victory.

For those who are thinking of the machines they want built for that tomorrow, FIDELITY has prepared a well-illustrated and comprehensive record of its experience, equipment and personnel. Send for your copy of "Facilities."

Designers and Builders of Intricate, Automatic Precision Machines

31 YEARS' EXPERIENCE

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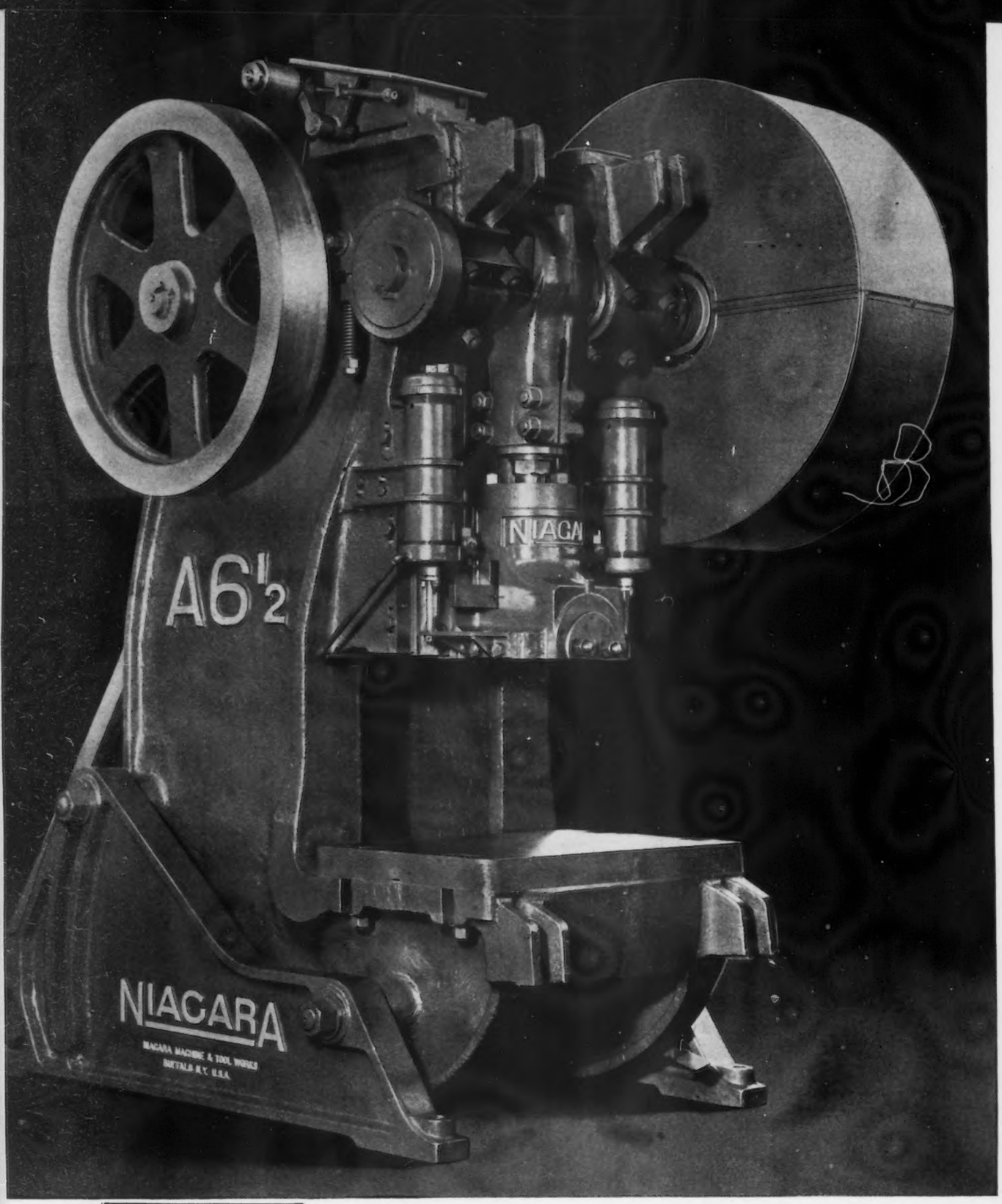
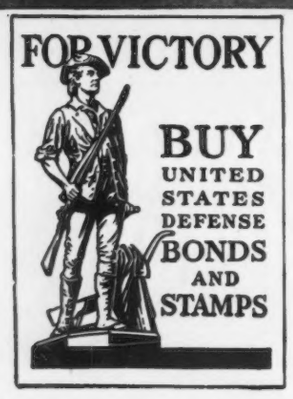




SERVING WAR PLANTS

Niagara Presses and Shears, some of which are illustrated on these two pages, are increasing output of fighting material. Just one example of their many advanced engineering features is the instant-acting Niagara 14-point engagement sleeve clutch which increases both the efficiency of the press and the operator, and results in—

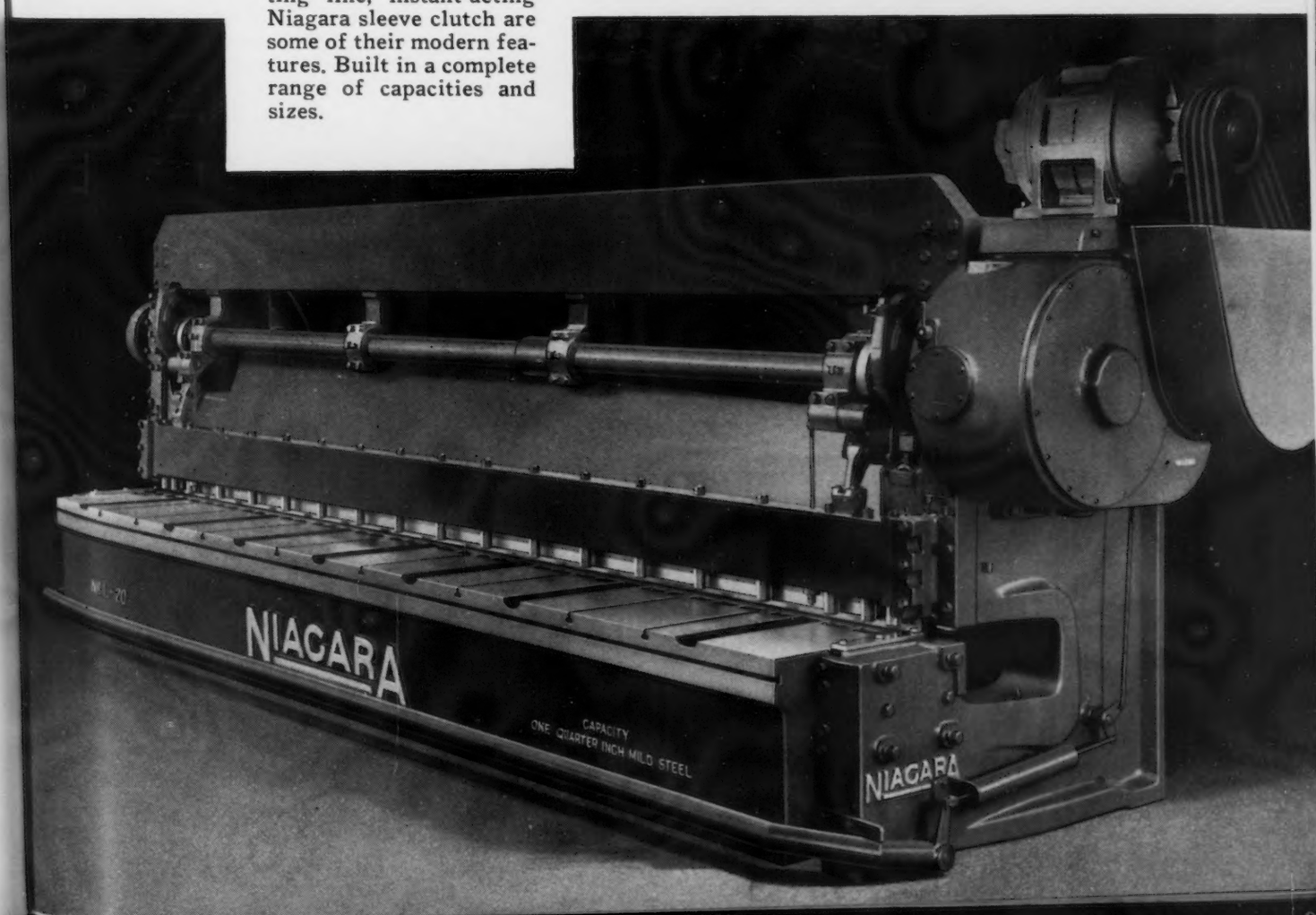
MORE PRODUCTION PER MAN-HOUR

NIAGARA MACHINE & TOOL WORKS

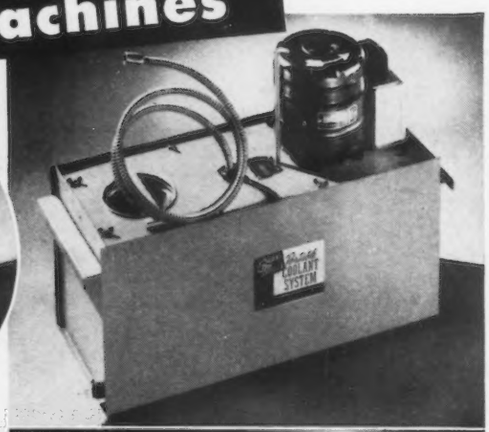
GENERAL OFFICES AND WORKS: 637-697 Northland Ave., Buffalo, N. Y., U. S. A.

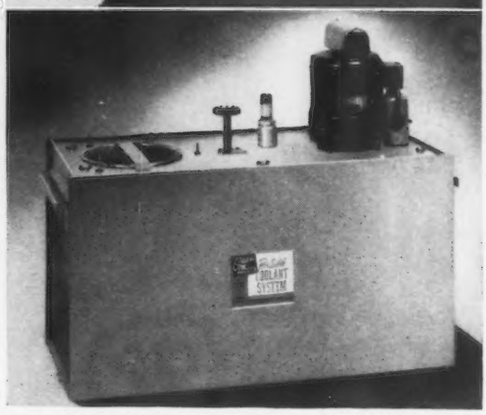
District Offices: **General Motors Bldg., Detroit; Leader Bldg., Cleveland; 50 Church St., New York**

More production per man-hour is being obtained in war plants using Niagara Power Squaring Shears. Convenient operation, quick, accurate setting of ball bearing self-measuring parallel back gages, full visibility of cutting line, instant-acting Niagara sleeve clutch are some of their modern features. Built in a complete range of capacities and sizes.



For TOP PRODUCTION on all Machines





Above: Standard Model — capacities up to 130 gals. per hour. Above, right: Heavy Duty "A" Series Model — capacities up to 165 gals. per hour. Right: Model H-10A Centrifugal — capacities 10 to 1,000 gals. per hour.

•

Use COOLANTS *Applied with* Gray-Mills *Portable* COOLANT SYSTEMS

PROPER application of coolants in metal working operations means increased production and time-and-tool savings. You can have these advantages for every machine — small, large and special — with Gray-Mills Portable Coolant Systems. They can be installed in a few minutes, are modern in design, and of heavy-duty construction with built-in quality to give trouble-free service.

Use Gray-Mills Portable Coolant Systems to modernize older machines, to equip small, large and special tools for greatest efficiency, and for emergency stand-by service. Pump sizes range from 50 to 1,000 gals. per hour, and pans, valves and fittings are available for your applications. Priced from $39.50. Call your distributor, write or wire:

GRAY-MILLS COMPANY
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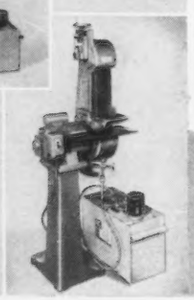
Left: Heavy Duty "A" Series Model speeds production of this milling machine.



Right: Heavy Duty "A" Series Model provides controlled coolant flow to this belt grinder.

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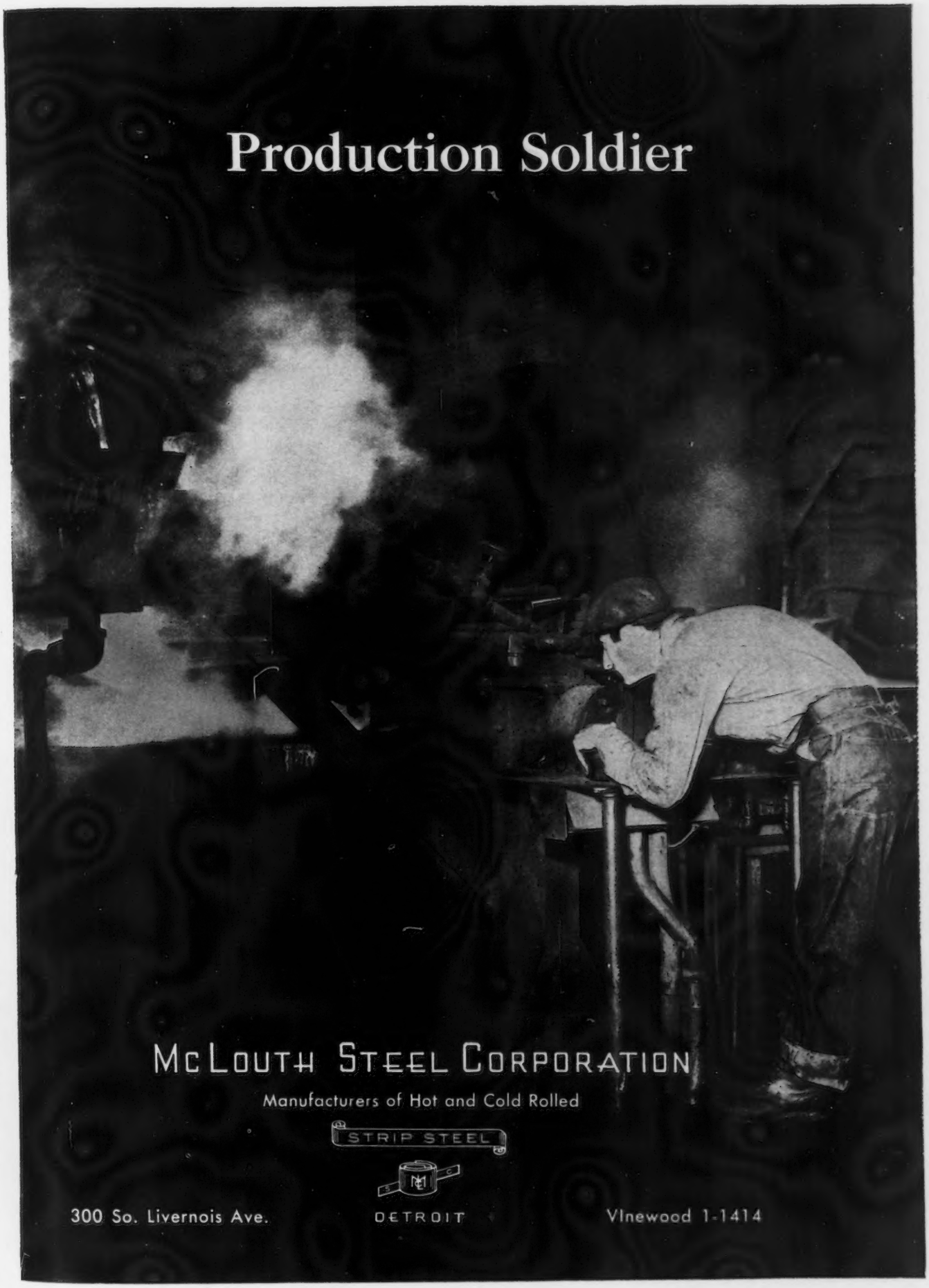
the six aluminum plants among his customers will ultimately require 600,000 kilowatts of Bonneville-Grand Coulee power. Five of these plants are reduction plants, the sixth, a huge rolling mill. Add to these the four plants producing or underway in California and Arizona and you have a fair sized aluminum industry. The sole fly in the ointment from the standpoint of establishing a local production line from ore to finished aircraft is the fact that the rolling and other forming facilities are but a fraction of raw metal capacity.

Coast magnesium facilities are not so far advanced in the production state as are aluminum, but a year from now, if indications are not deceiving, a rich chapter in metallurgical history will have been written. A year ago engaged only in pilot plant production on a massive scale, the lessons that have been learned since have brought the industry well out of the experimental woods.

Although much excitement and speculation has attended light metal plants, the West regards its new steel capacity with emphasis on pig-iron production, as the real symbol of its coming of age industrially. Unlike magnesium production, which has been held back by difficulty with reduction practices, actual pig iron and steel production in the West has been held back only by such a prosaic factor as construction difficulties and delays in delivery of materials. Scheduled to be blown in by this time, the new blast furnaces in both Utah and California still are receiving the finishing touches of artisans. The Geneva Works being erected by Columbia Steel Co., in Utah will rank among the country's first five integrated plants in size—and it won't rank fifth. At Columbia's own Provo, Utah, plant, a knocked-down blast furnace from an eastern subsidiary of the United States Steel Corp. is being reerected alongside the existing stack. Safe from enemy bombings, and located at substantially an equal distance from each of the three principal Coast market areas, these plants will feed existing Coast mills, now subsisting almost entirely on scrap, with an excess pig-iron production, and the Geneva plant will supply plates and structural steel to the shipyards.

Although dwarfed in size by the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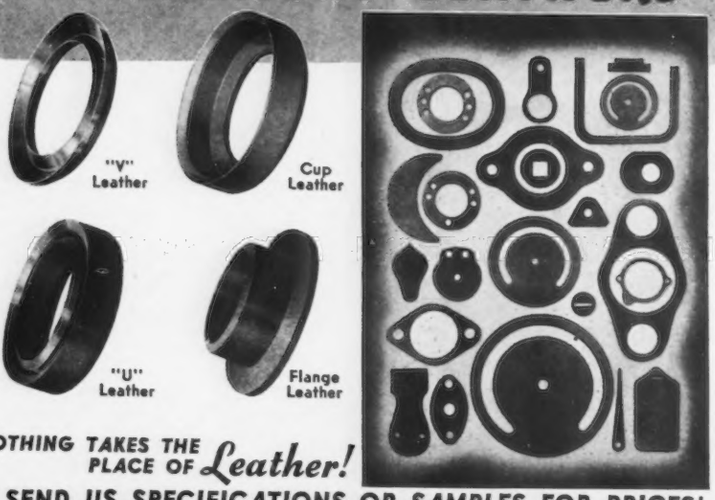

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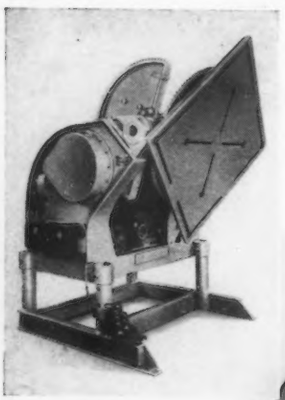

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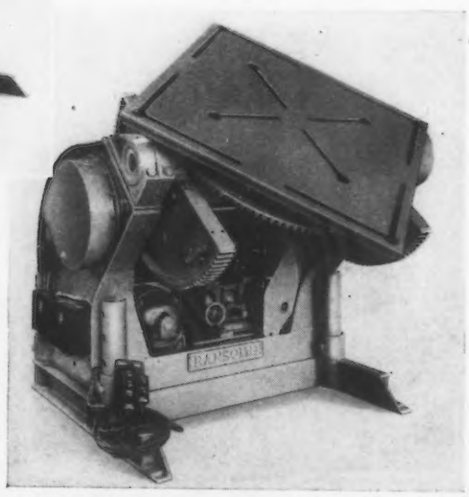

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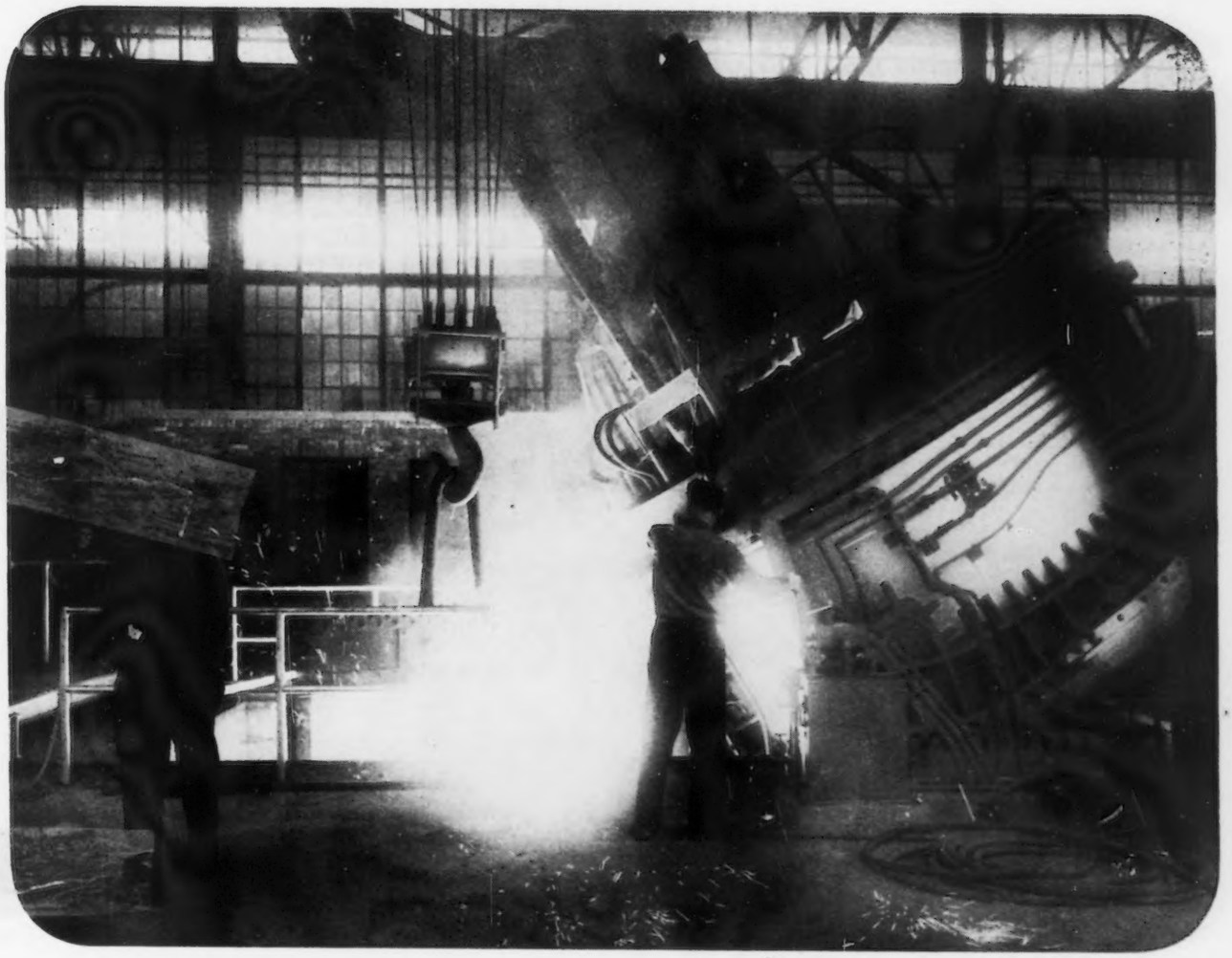
FEATURE CONTINUATIONS

Columbia expansions, the Kaiser Co., Inc. plant at Fontana, Cal., has garnered a lion's share of the publicity, first because of its sponsor, and secondly because it is built around the only blast furnace on the Coast. Although initial production will be at the rate of under 500,000 tons of ingots annually, and initial rolling confined to plates, additional facilities authorized within the past 60 days include a 50 per cent increase in steel ingot capacity, structural and bar mills, and refinements to the basic plants. Blueprints for the plant constitute a tacit admission that the facilities now authorized are but a beginning, and the entire layout is tailored to a far larger operation. From the standpoint of raw materials, the plant is unique in that coal for a modern by-product coke plant will be transported over 700 miles from Utah mines by rail, and that iron ore initially will be brought over 200 miles, also by rail.

Just as war gave the Coast its first great industries, so did it focus national attention on the first industrial giant both to rise and shine in the Far West, Henry J. Kaiser. Although he was a big league heavy construction contractor a decade ago, no Coast industrial poll would have nominated him as "most likely to succeed." In his own little sphere he prospered, partially because he was willing to back up with bids his faith in revolutionary, earth moving methods, to a large extent because he synthesized his considerable equipment, know how, and organization with a rugged group of erstwhile competitors whose buying methods avoided price ceilings and hugged price floors. Their popularity with the suppliers who vied for their considerable business was not great.

With the exception of the Permanente Canyon Magnesium plant, each of the materials producing ventures upon which Kaiser and his bodies have embarked have been outgrowths of difficulties in securing supplies from established sources coupled with confidence that new plants, embodying new technological methods could produce more cheaply than older plants saddled with unamortized, obsolete machinery. Erection of the Permanente Canyon Magnesium plant, most disappointing project so far, must have been at least partly due to the hope that natural gas needed to fire the kilns of the adjoining



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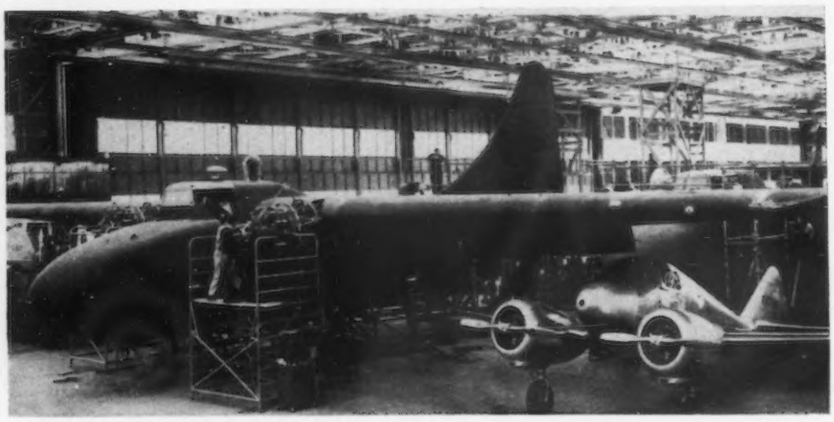
Kaiser cement plant, world's largest, could first be used as a chilling agent in the magnesium reduction process. The projects as a whole constitute a giant wager that the business boom will last long enough substantially to amortize the capital investment, allowing profitable operation despite high operating costs thereafter. Although Uncle Sam has a heavy stake in Kaiser enterprises, the failure would not be proportionately so great a loss to Uncle, or to Kaiser's associates, as to Kaiser himself. San Francisco financial circles believe that his entire personal fortune is involved in war production.

AMERICAN MOSQUITO: Similar to the British "Mosquito" plane this all-wood transport plane is shown nearing completion in a Curtiss-Wright plant somewhere in Missouri. The plane is slated to undergo flight testing soon. Known as the C-76 Caravan, this plane is designed for carrying airborne troops and parachutists into enemy territory. Note how its immense size dwarfs the Curtiss AT-9 under its wing. This C-76 type plane is reported being considered as the design to be built by Andrew J. Higgins in his Louisiana shipyards which are being converted for plane building.

Acme



$800,000 MAGIC: Precise tooling of Wright Cyclone engine cylinder heads which used to take 300 man hours now takes exactly 47 seconds in this $800,000 super-machine recently installed in the South Bend works of Studebaker. This machine handles 130 cylinder heads at one time and uses 162 tools during the operation.

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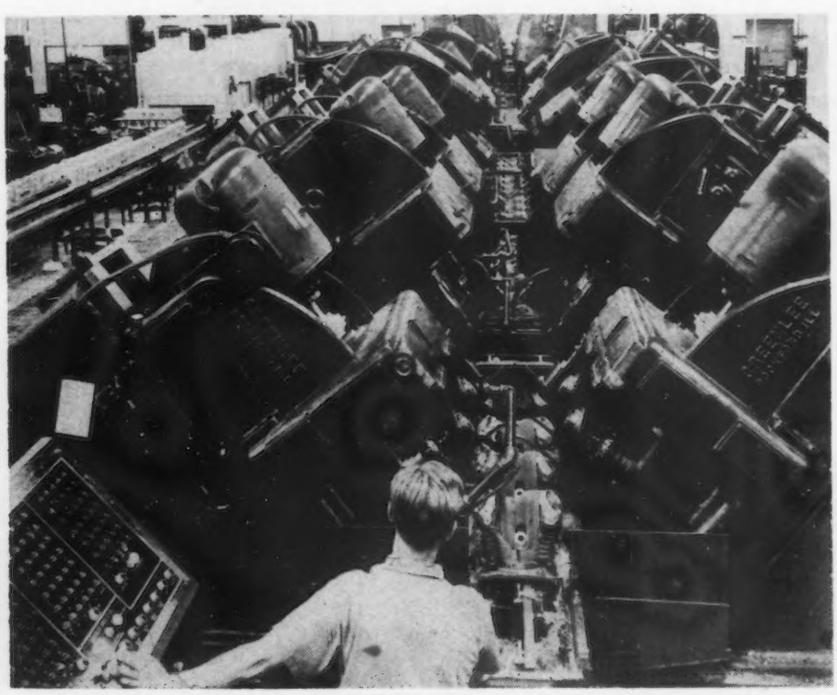

Because the sugar daddy of heavy construction during the depression dwelt in Washington, D. C., it was natural that contractors were well buttressed with legal talent there to guide them through the morass of penalties, conditions, and restriction with which Federal contracts are encompassed. Attorney-guides for the Kaiser group also happened to be familiar with the location of some gold claims close to the Capitol that turned out to be bonanzas. That was the biggest and possibly the only piece of pure luck in the whole saga.

The shipbuilding enterprises have brought more praise and poohpoohs to Kaiser than any of the other ventures. His associates have stayed in the background and let him catch both the orchids and cabbages. The orchids' fragrance is due to a record of having delivered, per shipyard way, more emergency vessels than anyone else. The cabbages' stink comes from the belief that more credit should go to standardized design enabling mass production than to the shipbuilder. The noes say that it is no mere trick to put a ship together in 14, or 10, or 4½ days from prefabricated sections than to set a cup on a saucer. The ayes point to the farm equipment shops and backyard foundries in the West Coast hinterland that are doing the prefabrication, pointing out that Kaiser has put them to use where the OPM with all its contract distribution staffs and elaborate pooling schemes fell down completely. Other Coast shipbuilders say they could have turned out more vessels of standardized design had not Kaiser pirated their key personnel, and the logging, mining, agricultural industries point to looming lumber, metal and food shortages because of mass migration of their personnel to the shipyards. The shipyards justify by pointing out that they alone topped the President's 1942 production goal. Sic transit the old school tie. How else could a Coast industrialist have gotten nationwide attention?

Chapter headings for most of the Kaiser enterprises have been written in dreamy statements by Kaiser on aluminum replacement, direct gas-reduced sponge iron, flying cargo planes. Text and footnotes have universally been inscribed in hard-headed technical language by the best engineers money can buy. So let it be with all new industry!